STEINER EDUCATION AUSTRALIA

AUSTRALIAN STEINER CURRICULUM FRAMEWORK 2011

MATHEMATICS HIGH SCHOOL
Extended Curriculum
Stage 3: Year 7

Original ACARA Recognition October 2011

Revisions included in this document:

April 2012	Numbering added to Content Descriptions and Achievement Standards, to enable cross-referencing
August 2013	Change to contents list numbering to match Topics in body: 7.1 Number& algebra 1&2 to 7.1 & 7.3 7.2 Geom & meas 1&2 to 7.2 & 7.3 as in doc
Sept 2014	Changes made to terminology relating to Aboriginal and Torres Strait Islander peoples, as per ACARA guidelines; Typing error fixed 7.2

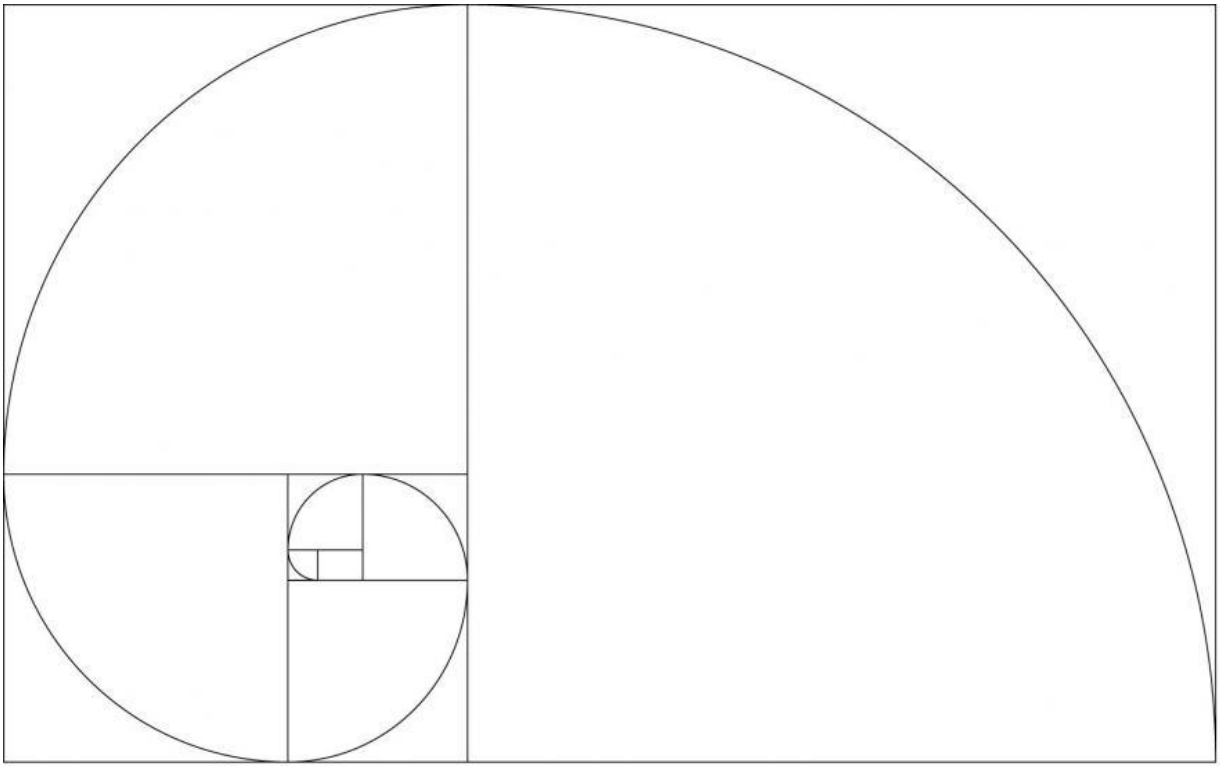
MATHEMATICS
Extended Curriculum Topics
Stage 3 YEAR 7

Contents:

Each Learning Area is organised into Topics. These are content areas which can be taught as one or more integrated thematic morning blocks (Main Lessons) over 3-4 weeks, with connected review and practice lessons developing the content throughout the year.

While it is necessary for the Content Descriptions to be covered, teachers are able to use their professional judgment concerning the needs of their Year: content can be recombined or reallocated into Main Lessons and practice lessons over the year.

YEAR 7: DEVELOPMENTAL PROFILE OF THE 13 YEAR OLD STUDENT	
DEVELOPMENTAL STAGE	**CURRICULUM APPROACH**
PHYSICAL GROWTH	
In Year 7, the students reach 13 years of age, and become teenagers. There is still accelerated growth in the limbs, and an associated awkwardness in movement. Sexual identity and capacity becomes established – in advance of psychological development, and the students become very conscious or self-conscious about their bodies. Sporadic bursts of energy and willingness to engage in physical activity vie with periods of lethargy.	Physical activity is important at this age, particularly for boys, who need a healthy outlet for their energy and developing strength in the muscles of the limbs. This activity should challenge their physical and attitudinal boundaries. In Mathematics, as much of the work as possible should be experienced practically or through movement eg. Jumping back and forth on a number line, discovering mechanical principles in Physics etc.
SOCIO-EMOTIONAL DEVELOPMENT	
There is a growing sense of self within the students, with a new relationship being established with the world as a teenager. This can manifest in the challenging of adult authority, and yearning for independence. This desire for independence and solitude is accompanied by feelings of anxiety, sensitivity, embarrassment and subdued introspection. There are significant differences between the way boys and girls deal with the onset of adolescence, and students tend to form strong friendships in small, tight-knit groups of their own gender. Students may develop crushes on teachers, sporting figures, actors, popular musicians etc as they search for role models and long to take their place in the adult world.	Students of this age need activities which engage both their actions and their thought, which will help them to understand the wider world in a way that is relevant to them. An increasingly democratic teaching style must emerge, while still maintaining a strong consistency of expectations and boundaries. Teachers appeal to individual judgment and encourage students to exercise social responsibility within the context of their Year community. To balance the preoccupation of the students with the turbulence of their inner world, teachers should endeavour to direct their attention and their newly acquired critical faculties towards an objective inquiry into the outer world.
COGNITIVE MATURATION	
This is the final stage of the second seven year phase, during which we witness the birth of the rational intellect out of the rich imaginative life of feeling. Conceptual thinking starts to come to the fore, and the student begins to develop critical abilities. Students are eager to expand their knowledge of the wider world. Steiner indications place the introduction of 'formal operations' and abstract thinking in the thirteenth year.	There is a continued need for the presentation of clear concepts grounded in practical applications in the outer world. Once the students display solid foundations in the logic, form and structure of Mathematics, they may be led towards increasingly intellectual and abstract concepts. Algebra develops out of the practical use of formulae, and students begin to discover its power as a method of describing problems, patterns and forms.
MORAL CAPACITY	
Rudolf Steiner described this stage as the development of 'earth' maturity, meaning that the students now fully engage with the wider outer world, while developing personal, individualised judgments about the truth. Students are encouraged to take initiatives and to challenge attitudes and knowledge which they formerly accepted on authority and in this way to formulate their own point of view. In the striving for individuality, students are encouraged to accept that others see the world differently.	The lessons support and encourage the students' interest in the affairs of the outer world, and provide opportunities for them to form their own judgments about experiences they have gained. The education of the will is important at this stage, and students are brought opportunities to develop self-restraint and self-motivation. Teachers should be conscious of helping students to develop a sense of responsibility, while overcoming apathy and fear which inhibit motivation.



Maths in Nature

Mathematics 7.1 Number and Algebra I

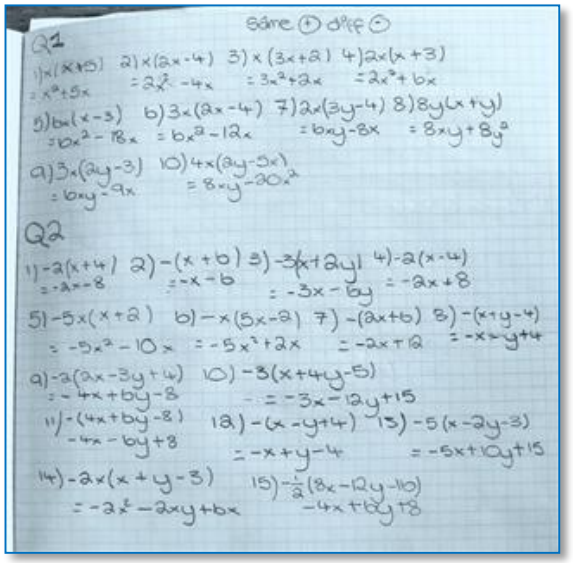
The Central Experience of the Content

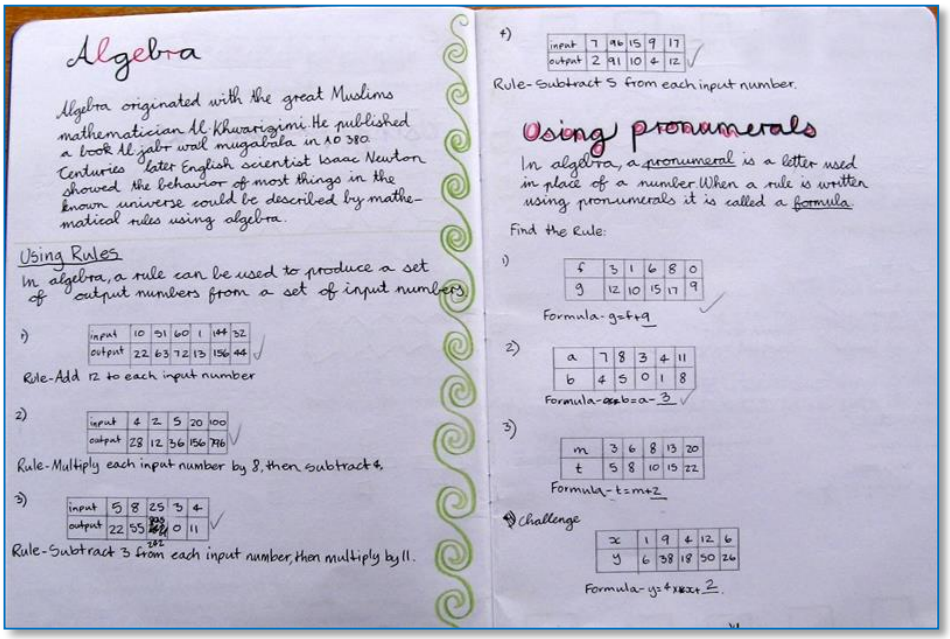
The introduction of Algebra represents a major conceptual leap for the students. While the concrete, logical rules and processes bring the children very much into their thinking realm, their new-found logical reasoning skills are applied to the representation of the concrete with the abstract. The rules and processes of Algebra are developed out of working with simple formulae and the use of pronumerals, brackets and negative numbers in equations as a technique for solving practical problems.

During this topic, the aims are to engender in the students an appreciation of how general rules of arithmetic become clear through algebra, and to enable the children to grasp the principle of balance in an equation.

Future Capacities

This Main Lesson seeks to bring to the children inner experiences of the stability and predictability of Mathematical laws, while offering versatile and practical problem solving techniques that satisfy their increasing interest in matters of the world. Conceptual thinking is strengthened, and students enjoy awakening to a feeling of the power inherent in their thought processes.





Content description

Mathematics 7.1 Topic: Number and Algebra I

During this topic, the study of Algebra is developed out of the application of formulae first presented in Year 6. Students will learn to:

1. Consolidate and extend number skills gained in previous years;
2. Practice the formulation of a mathematical statement or 'rule' from a sentence in words;
3. Apply the laws of Algebra once facility is achieved with the concept of pronumerals;
4. Become proficient with the use of brackets, order of operations and negative numbers;
5. Apply linear equations to the description and solution of number patterns and practical problems;
6. Understand index notation and encounter the powers and roots of numbers in problems;
7. Represent numbers as products of powers of prime numbers and use this as a strategy for simplification.

Content Elaboration

Learning Experiences	Multi-modal and Artistic Activities	Conceptual Knowledge and Skills
Students attempt to find the linear equation when given information in a word sentence and vice versa.	Students practise the formulation of equations from increasingly complex word sentences.	Students appreciate that a problem stated verbally may be described Mathematically and vice versa.
Students initially substitute a picture symbol for an object in an equation. This could be replaced by the first letter of the name of the object, and finally a commonly used letter eg. *x, y* or *z*	Students become familiar with the use of pronumerals by using them in a range of problems.	Students discover the power of Algebra to succinctly describe a Mathematical problem, also that a general solution may be developed.
Students discuss situations in which negative numbers are commonly encountered eg. winter temperatures.	Students could perform simple operations involving negative numbers by 'hopscotching' backwards and forwards on a number line on the ground.	Students discover the realm of negative numbers and the process of performing Mathematical operations with them.
Students use counters or objects to establish that $a + b = b + a$	Students could extend their initial experience of the Commutative law to problems involving pronumerals.	Students discover and employ the Commutative Law of Algebra.
Students use counters or objects to establish that $(a + b) + c = a + (b + c)$	Students could extend their initial experience of the Associative law to problems involving pronumerals.	Students discover and employ the Associative Law of Algebra.
Students use counters or objects to establish that $a \times (b + c) = (a \times b) + (a \times c)$	Students could extend their initial experience of the Distributive law to problems involving pronumerals.	Students discover and employ the Distributive Law of Algebra.
Students are challenged to represent numbers as products of powers of prime numbers.	Students could investigate the use of prime factors as a strategy for simplification of fractions involving pronumerals.	Students develop strategies for the simplification and solution of problems.
Students apply Algebra to the solution of practical problems.	Students could use Algebra to describe and solve problems involving speed, distance and time.	Students discover the power of Mathematics to describe real life situations.

Mathematics 7.2 Geometry and Measurement I

“God ever geometrises” Plato

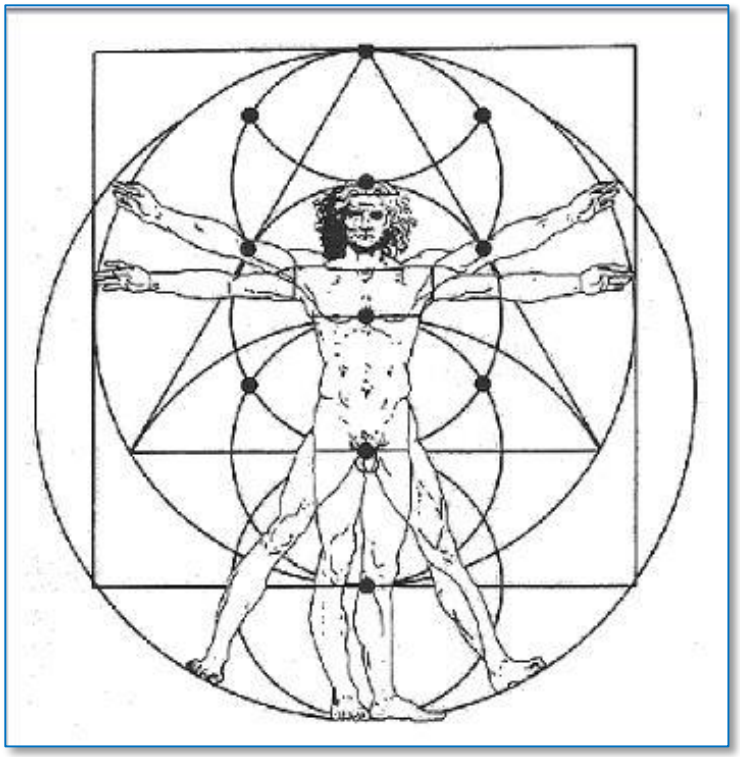
"Without mathematics there is no art." Luca Pacioli

The Central Experience of the Content

This topic draws its inspiration from Plato’s idea that the geometry that permeates the Universe is the visible, crystallised expression of creative thought. Through this topic, the students discover where and how geometric archetypes precipitate as organic and inorganic forms within and around us. The theorem of Pythagoras is presented in relation to his biography and the Mathematical knowledge held by the classical cultures. Beginning with constructions placed within the circle, emphasis is placed on stellar and spiral forms, the pentagon, divine proportion, and the Mathematics inherent in the arts, nature, the built environment and the human body.

Future Capacities

The awakening of the search for truth in students of this age group presents an opportunity for a glimpse into the profound mathematical truths behind the order of nature. The geometry of the Golden Mean allows an exploration of these laws through a study of the ratio in both the human form and the Universe that embraces it. During this topic the student synthesises and deepens much of the work in mathematical patterns of earlier years. The students gain an appreciation of the harmony of the world as made manifest in form and number.



Content Description

Mathematics 7.2 **Topic: Geometry and Measurement I**

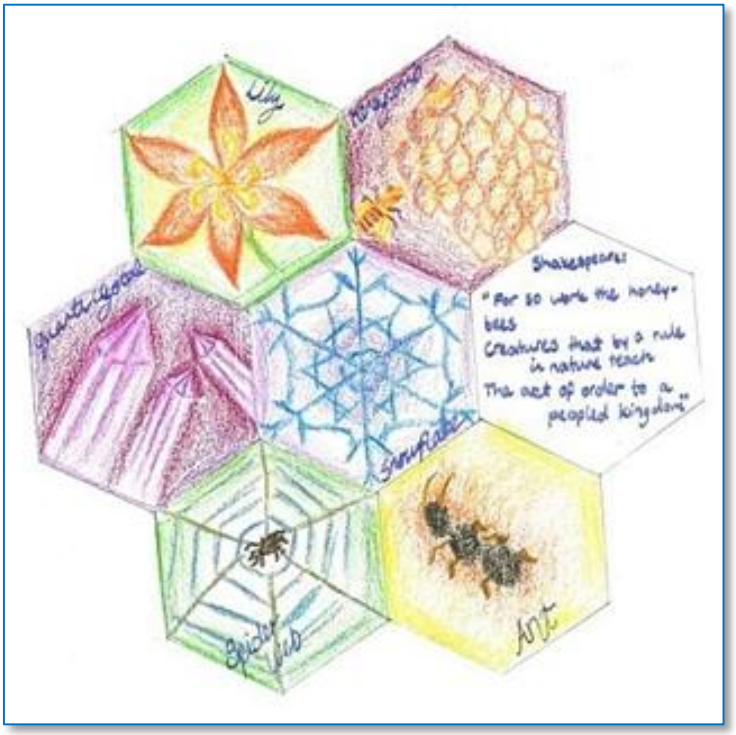
Students will learn to:

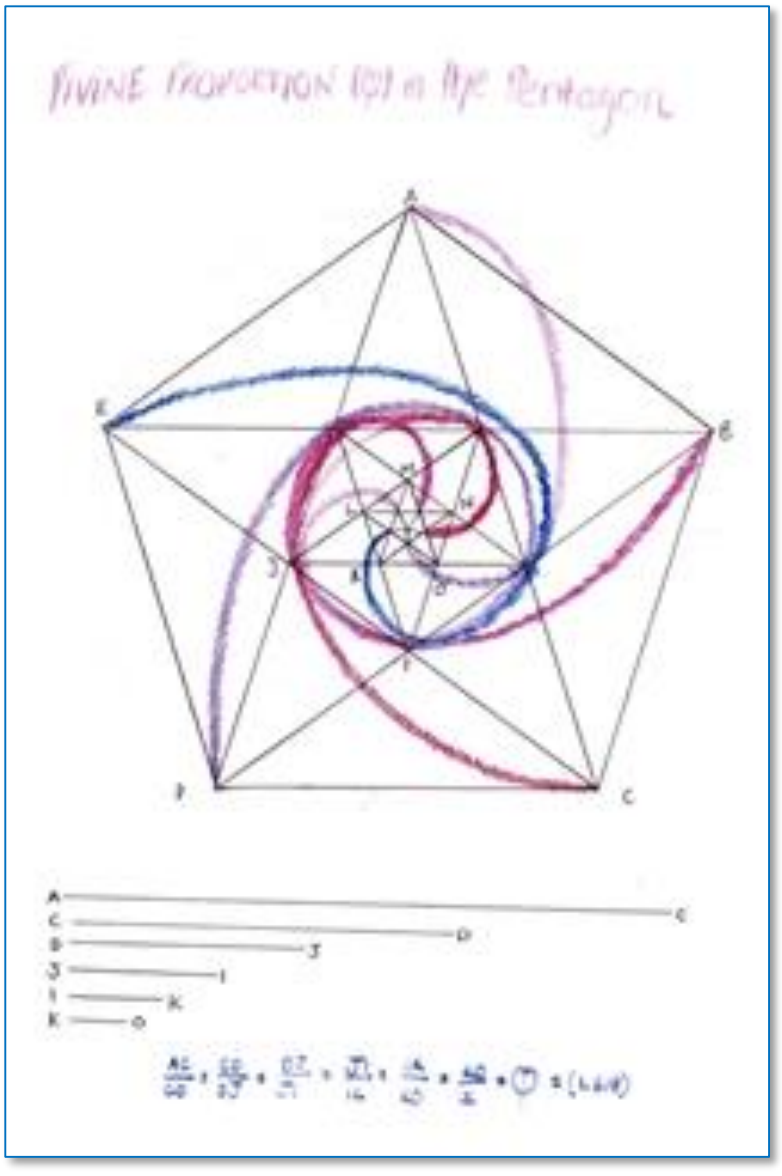
1. Review and extend the construction skills learned in Year 6;
2. Gain insight into the historical context of Pythagoras and his biography;
3. Investigate the theorem of Pythagoras;
4. Draw constructions placed within the circle, stellar forms based on hexagons and pentagons;
5. Construct and compare different types of spirals with examples found in the world;
6. Construct the pentagon to reveal the Golden Ratio inherent in its form;
7. Discover and investigate divine proportion, the Fibonacci Sequence, and the Mathematics inherent in the arts, nature, the built environment and the body of the human being.

Content Elaboration

Learning Experiences	Multi-modal and Artistic Activities	Conceptual Knowledge and Skills
Students revise their construction skills.	Students could revise construction techniques such as bisections and perpendiculars.	Students reacquaint themselves with the drawing equipment and construction techniques.
Students hear the biography of Pythagoras and the discovery of the theorem that bears his name.	Students could prove Pythagoras' Theorem in a number of different ways.	Students come to an understanding of Pythagoras' Theorem by experiencing it dynamically, and appreciate its significance in the historical development of Mathematics.
Students practise their skills in the correct and accurate use of drawing instruments.	Students could construct forms and patterns within the circle based on the hexagon and pentagon.	Students come to an understanding of the need for careful, accurate construction in order to produce beautiful geometric forms.
Students observe the spiral forms of a coiled rope, snail shell etc.	Students could construct various spirals such as Archimedean, logarithmic etc.	Students appreciate the power of Mathematics to describe forms and patterns found in the outer world.
Students cut apples, papayas etc. to reveal the pentagonal symmetry within.	Students could construct the stellar pentagon and establish the ratios within the form by measurement and calculation.	Students discover the Golden Ratio as a measure inherent in natural forms.
Students are introduced to the rabbit puzzle proposed by Fibonacci.	Students could represent the rabbit puzzle by laying out counters, drawing it etc.	Students discover the number pattern that leads to the Fibonacci Series.
Students generate successive terms of the Fibonacci Series.	Students could find the value of the ratio of successive terms of the Fibonacci Series.	Students discover the connection between the Fibonacci Sequence and the Golden Ratio.

Content Elaboration **Learning Experiences**	**Multi-modal and Artistic Activities**	**Conceptual Knowledge and Skills**
Students collect flowers and count the number of petals, observe pine cones, pineapples, sunflowers, cacti, phyllotaxis of certain plants etc.	Students could record the number of petals on flowers, count the number of spirals on a pine cone or pineapple, draw the branching patterns of certain plants etc.	Students discover the Fibonacci numbers inherent in the natural world.
Students measure the height of their navel and their total height.	Students could find the ratio of navel to total height, calculate the average ratios of the whole Year, and investigate other proportions in the human body.	Students come to an appreciation of the divine harmony inherent in the proportions of the human body.
Students are given pictures of buildings such as the Parthenon, the Notre Dame, the Taj Mahal, the United Nations building; and paintings by Da Vinci, Seurat, Edward Burne Jones, Dali etc.	Students could measure the height and width of significant features of the paintings and buildings and find the ratios of these dimensions.	Students come to an appreciation of the use of the Golden Ratio to impart visually aesthetic proportions to art and architecture.





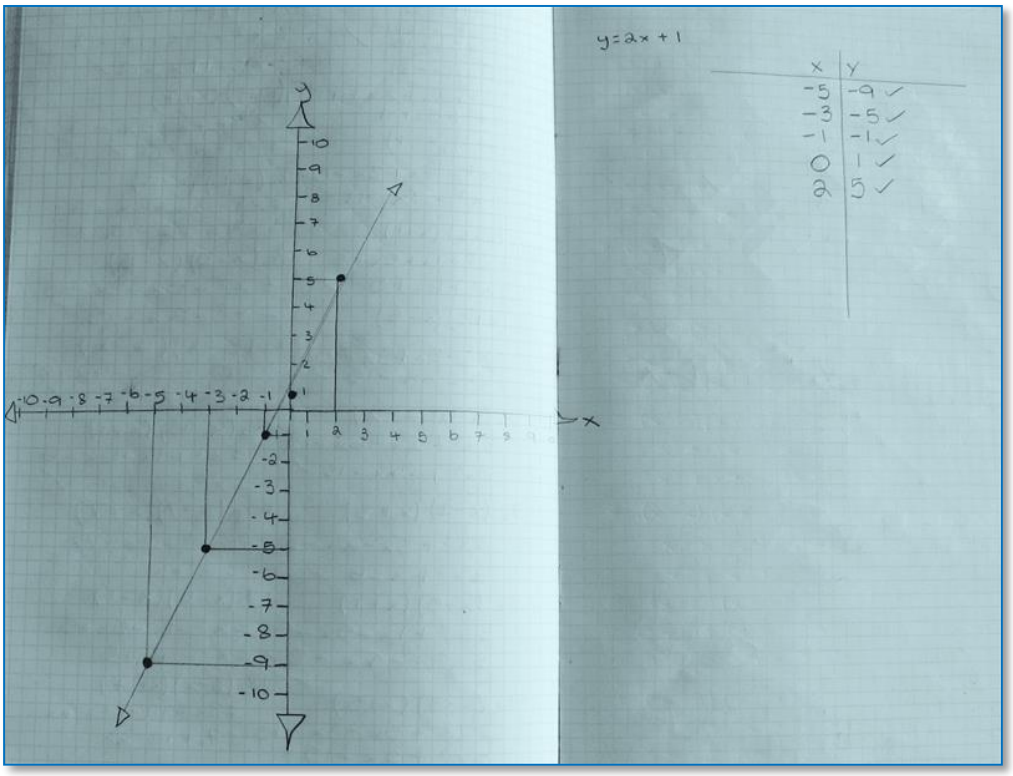
Mathematics 7.3 Number and Algebra II - The Cartesian Plane

The Central Experience of the Content

Once students are comfortable with moving between the negative and positive numbers on a number line, two number lines can be placed perpendicular to one another, giving rise to the Cartesian Plane. The set of axes provides a framework or grid where a point or set of points can be located on a two dimensional plane. What begins as an exercise in describing the exact location of an object in planar space is extended to the graphical treatment of linear equations.

Future Capacities

The master artists of the Renaissance used a grid, in the form of a wire mesh, as a tool for dealing with the subjects they painted. Through this topic, the students come to an appreciation of the power of Mathematics to exactly describe the location and form of an object in space. This stimulates the students' mobility of thought, and develops their two dimensional visualisation skills. This topic is an introduction to the use of graphs to visually describe Mathematical relationships, and is a concept that is continually developed over the course of the curriculum.



Content Description

Maths 7.3 Topic: Number and Algebra II - The Cartesian Plane

Students will learn to:

1. Use a co-ordinate system to locate points, lines and objects in a plan;
2. Develop the picture of this grid or framework and extend it to encompass the four quadrants of the Cartesian Plane; Use patterns of points that are in a linear relationship allows to anticipate other points in the same sequence;
3. Understand that these patterns gives rise to the Algebraic description of a linear relationship;
4. Express these on the Cartesian Plane as a straight line graph;
5. Perform simple surveys and probability experiments;
6. Investigate and compare the use of tables and different types of graphs as a means of presenting these data visually, and evaluate their effectiveness in different contexts, such as encountered in the media.

Content Elaboration Learning Experiences	**Multi-modal and Artistic Activities**	**Conceptual Knowledge and Skills**
Students arrange their desks in a grid and describe the location of each individual's desk by employing a co-ordinate system.	Students could construct pictures by joining dots which are located by being given a set of co-ordinates, or games such as 'Battleships' may be played.	Students become familiar with a means of pinpointing the exact location of points or objects in a plane.
Students arrange two number lines so that they lie mutually perpendicular to one another, crossing at the zero points of each.	Students could repeat the above activities, but with co-ordinates that are a combination of positive and negative numbers.	Students become familiar with using co-ordinates in all four quadrants of the Cartesian Plane.
Students plot points on the Cartesian Plane that are in a linear relationship with one another.	Students could describe the pattern formed by plotting points from a table and suggest another set of points that might form the same pattern.	Students develop an understanding of the pattern that underlies a linear relationship and its graphical representation.
Students plot points on the Cartesian Plane that are in a linear relationship with one another.	Students could deduce the 'rule' that describes the relationship between the points.	Students discover the linear equation: $y = mx + c$
Students sketch the graph given a linear equation.	Students could investigate the effects on the graph of varying the values of m and c, and establish that parallel lines have the same gradient.	Students gain a thorough understanding of the linear equation, and appreciate the link between the Algebraic statement and the graphic representation of the linear relationship.
Students perform simple probability experiments	Students could investigate and compare different ways of representing the data obtained.	Students evaluate the effectiveness of a range of ways in which information can be visually portrayed.
Students simple surveys.	Students could investigate and compare different ways of representing the data obtained, as well as investigating the representation of data in the media.	Students evaluate the effectiveness of the representation of data in the media.

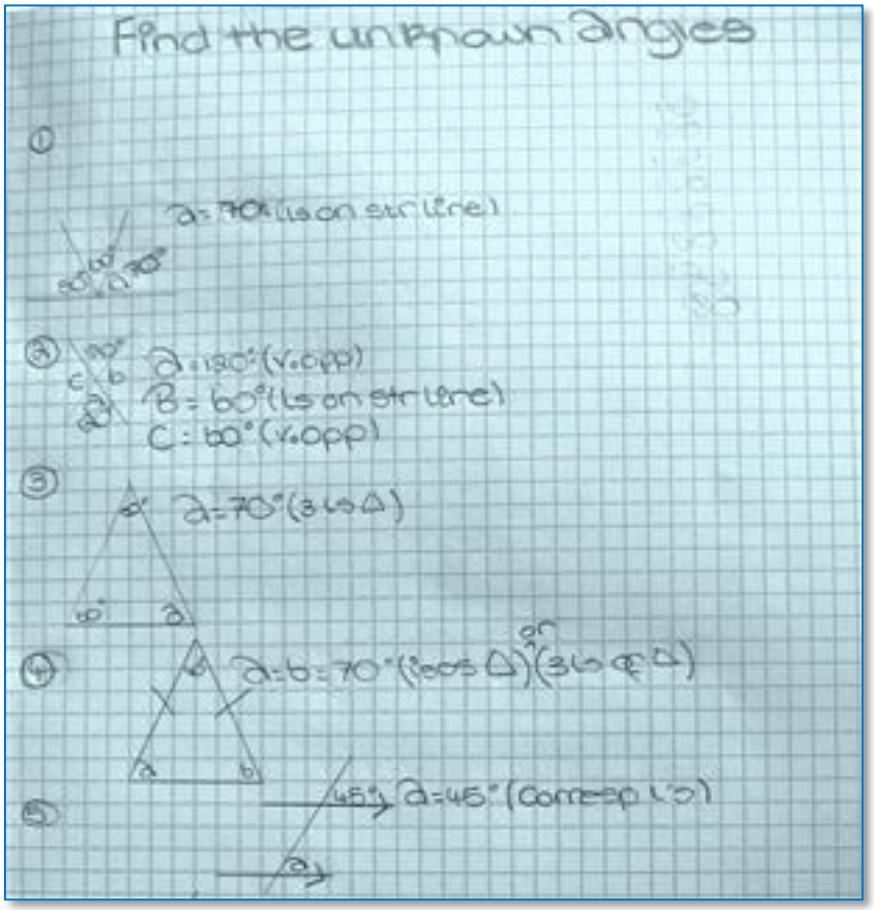
Mathematics 7.4 Geometry and Measurement II

The Central Experience of the Content

This topic moves from the construction and investigation of the properties of shape in two dimensions through the metamorphosis of shape to the challenges of representing three dimensional forms in perspective. Throughout the topic there must live within the students an experience of the freeing of geometrical figures from their rigidity and endowing them with movement.

Future Capacities

The dynamic treatment of form is emphasised in this topic, and students develop mobility of thought as they are required to visualise and manipulate shapes in the imagination. Metamorphoses of form such as translations, reflections and rotations strengthen two and three dimensional spatial visualisation skills. This is augmented by the students' experiences in drama, movement, and perspective drawing, all of which serve to ground the Mathematics in practical reality.



Content Description

Maths 7.4 Topic: Geometry and Measurement II

Students will learn to:

1. Understand the theorems that describe the properties of parallel lines and triangles;
2. Develop the ability to clearly, concretely and accurately describe form through a treatment of the areas of parallelograms, trapeziums, non right angled triangles and simple and compound shapes by construction and calculation;
3. Work with the metamorphosis of form through the concepts of ratio and proportion, scale, translations, reflections and rotations of shapes;
4. Undertake perspective geometry and drawing in conjunction with Art lessons and topics on the Renaissance and discover how artists of the Renaissance discovered the vanishing point, and practice perspective drawing of objects, rooms, buildings etc.

Content Elaboration

Learning Experiences	**Multi-modal and Artistic Activities**	**Conceptual Knowledge and Skills**
Students accurately construct triangles.	Students could measure all the angles in the construction and draw conclusions from their observations about the interior and external angles of a triangle.	Students discover the theorems that pertain to triangles.
Students are presented with problems where unknown angles must be found.	Students could find the unknown angles by employing the theorems that they have discovered.	Students develop the ability to apply sequential logic to a geometric problem.
Students construct more complex shapes, such as parallelograms, trapeziums, compound shapes etc.	Students could find the areas of the shapes by measurement and calculation.	Students discover and use the formulae for the area of various shapes.
Students experiment with transforming shapes that they have constructed, and describing how the new shape differs from the original.	Students could practise transforming shapes by employing the concepts of ratio and proportion, scale, translation, reflection and rotation.	Students discover and become familiar with various ways to describe the dynamic metamorphosis of form.
Students draw simple scenes such as landscapes with a road and telegraph poles receding into the distance, railway tracks, fences etc.	Students could practise the use of perspective drawing to depict increasingly complex scenes.	Students discover and appreciate the use of the vanishing point and other perspective techniques.

Achievement Standard Year 7

1. By the end of Year 7, students have experienced practical situations in which negative numbers occur, and are able to locate and represent them on a number line, including fractions and mixed numerals. They encounter index notation, powers and roots in problems involving numbers and pronumerals. Students experience problems relating to ratio and proportion, and problems involving speed, distance and time in practical contexts.

2. Students review and extend the use of substitution and order of operations to solve formulae and algebraic expressions, and the use of a variable as a representative of a number. They encounter and apply the associative, commutative and distributive laws to algebraic expressions. Students discover the Fibonacci sequence and the Golden Ratio, and investigate how these are reflected in in a broad range of contexts such as nature, music, art, architecture and the human body.

3. Students become familiar with the use of co-ordinates to describe the location of an object in planar space, and extend this understanding to the investigation of linear relationships by plotting points on a Cartesian Plane. They interpret and describe features of straight line graphs, investigate the various methods of plotting straight line graphs, and are able to deduce the equation from the graph.

4. Students encounter and solve simple linear equations, both graphically and algebraically, and investigate the metamorphosis of form through the concepts of ratio and proportion, scale, symmetry, and the transformations of linear relations and simple polygons on the Cartesian Plane. They are able to apply the principles of perspective drawing encountered in their work on Renaissance art.

5. Students perform simple surveys and probability experiments, investigate different ways of representing data, and evaluate the effectiveness of ways in which information is portrayed in the media.

6. Students review and extend their previous work on the construction of patterns based on circle divisions and stellar polygons, and construct more complex shapes. They extend their previous work on area and perimeter, and encounter more complex problems involving parallelograms, trapeziums, non right angled triangles and compound shapes.

7. Students investigate, construct and measure angles arising from a transversal cutting parallel lines. They encounter and apply the theorems relating to alternate, corresponding, co-interior and vertically opposite angles, as well as interior and external angles of triangles. Students solve problems based on parallel lines, quadrilaterals and triangle theorems, including finding unknown angles and proving that lines are parallel.

8. Students encounter the biography of Pythagoras, and discover various proofs and applications of Pythagoras' Theorem.

General Capabilities

Literacy

Students are able to integrate the development of literacy skills throughout the mathematical topics in year 7. In Mathematics they continually develop and extend their ability to present information in the form of tables, graphs and visual texts. Students encounter more text-based statements of mathematical problems, and topics such as 7.2 and 7.4 allow for the possibility of students generating research projects and written presentations.

Numeracy

In year 7, students increasingly recognise and understand the role of Mathematics in both their personal lives and the world around them. They are presented with opportunities to develop confidence in their ability to describe, represent and solve problems, and apply mathematical thinking to other learning areas.

Information and communication technology (ICT) competence

At this point the students are not exposed to the use of calculators and digital technologies. The focus remains on the development of robust thinking and problem solving skills without reliance on digital technology. The solid foundations established in the understanding of mathematical processes lead to a more informed and effective use of digital technology when it is introduced in year 8.

Critical and creative thinking

Students in year 7 develop critical thinking as the faculties of intellectual thought continue to awaken within them. They increasingly encounter and employ causative logic in their experience of Mathematics. The consideration and development of solution strategies to a variety of problems requires the students to exercise reason and is indicative of their increasing development of a sense of discernment.

All the topics are imbued with a creative element that encourages the students to look at Mathematics from a variety of perspectives. Creative thinking skills are encouraged as a means of developing original or alternative approaches to problem statement and solution. Geometry is appreciated both as an accurate visual and artistic representation of form, and as a means of discovering the properties of shapes.

Ethical behaviour

At this age students increasingly identify and articulate their individual moral stance to personal, family, school and world issues. There are many opportunities in Mathematics to engage with and develop values, ethical principles and moral integrity.

Personal and social competence

As students enter puberty and transition from childhood into adolescence, they develop an increasing interest in the workings of the outer world. Their social interactions and immediate peer group are priorities for them as they learn and experiment with managing themselves, their relationships and their school life. Topics in Mathematics are investigated both individually and in group contexts. Students develop the ability to work both independently and co-operatively in teams, thereby nurturing positive social interactions. Mathematics continues to be presented as a quintessentially human endeavour that is intrinsic to the history, culture and development of the human being.

Intercultural understanding

Students appreciate that the evolution of Mathematics has taken place within the context of the development of human culture over the course of several different epochs of history. They are presented with the biographies and contributions of Mathematicians from cultures as diverse as the classical Greek and Mediterranean civilizations, Persian and Middle East cultures, Egyptian, Arabic and Islamic cultures, as well as European, Asian, African and Aboriginal and Torres Strait Islander cultures. Students learn to appreciate and respect the cultural differences between people and build a capacity for imaginative empathy, which is understood to provide a firm foundation for moral conscience, ecological awareness and global citizenship.

Opportunities arise within all the topics in year 7 to expose students to the mathematical thinking and contributions of other cultures.

Cross-Curriculum Priorities

Histories and cultures of Aboriginal and Torres Strait Island peoples

It is possible for content selection for many of the topics in year 7 to include material from Aboriginal and Torres Strait Islander histories and culture. In topic 7.2, students could investigate geometric patterns employed by Aboriginal and Torres Strait Islander cultures in their art. In topic 7.4, students could investigate the methods employed by Aboriginal and Torres Strait Islander cultures to represent the shape, form, area and perimeter of land and territories.

Asia and Australia's engagement with Asia

It is possible for content selection for many of the topics in year 7 to include material from Asian history and culture, in similar ways to the integration of Aboriginal and Torres Strait Islander histories and culture mentioned above.

Sustainability

Students are exposed to scenarios, problems and situations in which they have the opportunity to consider ways in which more sustainable patterns of living can be developed. Mathematics provides understanding and skills that contribute to the evaluation, quantification and interpretation of information relating to social and environmental problems. Topics 7.2 and 7.3 are particularly suited to offer opportunities for investigating issues relating to sustainability.

Links to Other Learning Areas

In general the close interrelationship of subject areas in ASCF strengthens the crossover of the foundational skills students develop in Mathematics.

The Mathematics topics are aligned to other subject areas such as the link with Science and English in topic 7.1; Art, Science, History, Geography and Eurythmy in topic 7.2; Art, Science, History and English in topic 7.3; Art, History, Drama and Eurythmy in topic 7.4.