Mathematics Learning Area

Introduction

The **Mathematics Learning Area** allows learners to develop mathematical skills and understandings that they can apply to many areas of life. They will develop sound strategies for investigating and problem-solving as well as positive attitudes about their capacity to effectively and creatively use their mathematics in many life situations.

Strands

The outcomes are organised globally into three strands – Spatial Sense, Measurement and Data Sense, and Number Sense – covering from the start of schooling until Band 3 (which includes the Year 7 National Numeracy Benchmarks). For Bands 4, 5 and Beyond Band 5, Spatial Sense and Measurement and Data Sense reconfigure into Space and Measurement and Chance and Data, while Number Sense separates into Number Sense and Algebra.

Spatial Sense

Learners develop and use spatial, or geometric, concepts including the shape and structure of objects, how objects can be transformed and how symmetry can be used. They also learn about position/location and mapping/arrangement. The Spatial Sense Strand includes the elements of *Features and Applications of Shapes, Pattern and Transformation,* and *Location.*

Measurement and Data Sense

Learners develop and use techniques and tools of comparison through measurement and chance variation. Estimation and calculation of length, area, volume, capacity, mass, angle, time and temperature for the purposes of comparing everyday situations is a key focus. They also develop confidence in using standard formulae and known ratios, rates and scales. In Data Sense, learners develop and use chance concepts and how they are expressed. They also develop data-handling processes and learn of their appropriateness, make predictions from data and judge the reasonableness of those predictions. The Measurement and Data Sense Strand includes the elements of *Estimating and Measuring, Using Relationships, Time, Chance* and *Data Sense.*

In Bands 4, 5 and Beyond Band 5, the Spatial Sense and Measurement and Data Sense Strands reconfigure into **Space and Measurement** and **Chance and Data**. The Space and Measurement Strand unifies the precision of geometric construction with

increasing accuracy through refinement of measurement skills and concepts. This strand includes the elements of *Spatial Features*, *Choosing and Using, Relationships,* and *Formulae.* The Chance and Data Strand explores both the fields of experimental and non-experimental data collection and includes the elements of *Posing questions and collecting data, Experiments involving chance, Presenting and Summarising Data,* and *Interpreting Data*.

Number Sense

Learners develop and use number concepts and notation, number patterns and skills. They also develop and use a range of computational strategies (mental, written and calculator). This strand separates into **Number** and **Algebra** for Bands 4, 5 and Beyond Band 5. Algebra learners represent generality and variability and, at the same time, reduce complexity. They also extend this notion to develop the ideas of functions and equations essential for studying more sophisticated mathematics in the senior years. The Number Sense Strand includes the elements of *Numbers and Number Systems, Patterns and Relationships,* and *Calculating.*

National Numeracy Benchmarks

The benchmarks are **blue** within the appropriate levels of the mathematics outcomes and indicators. Learning experiences that will effectively develop numeracy in learners are frequently accessed and used across the entire curriculum and within a wide range of real life contexts.

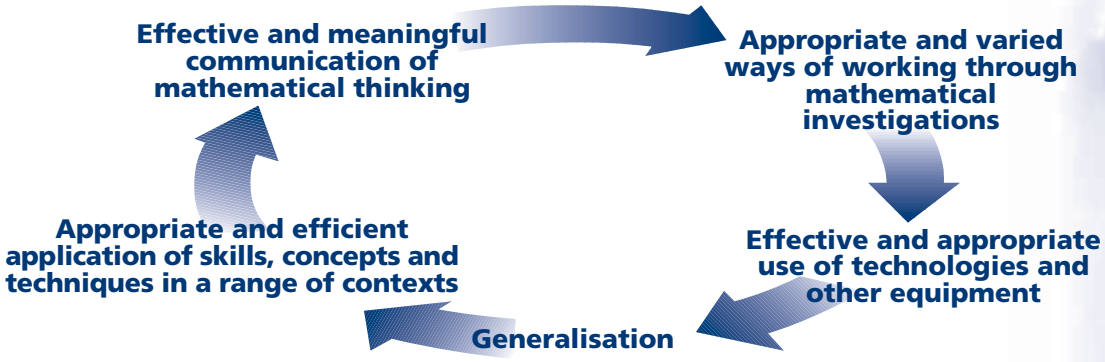
Working Mathematically through EsseNTial Learnings

The entire process of **Working Mathematically** has been embedded in the **Constructive Learner** and **Creative Learner** domains of the EsseNTial Learnings. The Constructive Learner domain focuses on the elements that learners need to become lifelong producers and contributors. In this case, they use their mathematics appropriately and effectively to do so, and justify the strategies they use. The Creative Learner domain contributes to the development of working mathematically in relation to creative problem-solving. Components of the Inner Learner domain, particularly reflective thinking and the use of meta-cognitive processes, also contribute to working mathematically. Mathematics provides ample opportunities to develop the attributes of the Collaborative Learner domain.

As well, five **key overarching mathematical outcomes** have been identified as 'big ideas' that inter-relate with all strands and elements of mathematics. These are all identifiable components of **Working Mathematically** and, as such, are linked explicitly with the EsseNTial Learnings. As outcomes in their own right, these aspects must be taught in tandem with the strand/element outcomes and be evident, where appropriate, in all indicators. The key overarching outcomes are:

1. **Appropriate and efficient application of skills, concepts and techniques in a range of contexts**. This is encapsulated in all aspects of the Constructive Learner. Within this outcome, learners identify, collect and organise mathematical information relevant to the task. They choose and use a range of strategies, technologies and techniques and persist with trying alternatives until they succeed. Finally, they justify their methods and assess the reasonableness of their solutions.

2. **Effective and meaningful communication of mathematical thinking**. This is clearly reflected in all aspects of the Collaborative Learner. When demonstrating this outcome, learners both interpret and express mathematical language with increasing levels of sophistication. They deconstruct mathematical language using strategies such as scaffolding, where appropriate. They explain mathematical ideas in their own words/ways, including presenting results and findings. They take audience into account by using appropriate notation and terminology and use technologies as visual aids to enhance their investigative reports.
3. **Appropriate and varied ways of working through mathematical investigations**. Due to the diversity inherent in this overarching outcome, the links to EsseNTial Learnings include all aspects of the Creative Learner, Inner Learner 1 to 3 and Collaborative Learner 4. Learners must be able to work both collaboratively and independently when planning, organising, undertaking and reporting on mathematical investigations. In more substantial investigations, this requires a high degree of persistence and intrinsic motivation. In the case of collaborative work, well-developed negotiation skills and the capacity to contribute to a team are a must.
4. **Effective and appropriate use of technologies and other equipment**, including the ability to recognise, link and extend multiple representations. This is clearly aligned with Constructive Learner 1 and 2 and involves choice and justification of appropriate equipment, including use of technology as a computational storage and display device during enquiry. It also includes an awareness of the limitations of technology and, increasingly, a capacity to assess the reasonableness of the results generated through use of technology. For example, recent graphing technologies have highlighted a need for learners to be aware of the nature of their solution to enhance their choice of an appropriate scale. As technologies continue to grow and change, the critical literacies involved will become further amplified as part of this outcome.
5. **Generalisation** aligns mathematics with the sciences and differentiates it from other disciplines. In the context of school mathematics, generalisation is most apparent when learners are given a context or problem that they explore and express in their own words. Exploring the problem includes organising the data, identifying a pattern, making conjectures and checking these against the data. Learners then make a generalisation, justify it and apply the generalisation to other contexts.



The five overarching mathematical outcomes are clearly inter-related, both with each other and the strand/element outcomes and the EsseNTial Learnings domains of the *Nothern Territory Curriculum Framework* (NTCF). They provide the rationale for teaching, assessing and reporting learners' mathematical achievements in a rich process-oriented manner that not only develops the skills and deep conceptual understandings but also the working mathematically orientation that is critical to the mathematical empowerment of all learners.

Strands and Links	Learners demonstrating evidence of KGP 1	Learners demonstrating evidence of Key Growth Point 2	Learners demonstrating evidence of Key Growth Point 3
Spatial Sense **Links** **EsseNTial Learnings:** Cr 1, Con 1, Con 2, Collaborative Learner **Learning Areas:** The Arts, SOSE, Technology and Design	**SS KGP1** attend to, anticipate, respond to, initiate interaction with and explore sensory stimuli using their senses (auditory, visual, tactile, and/or kinaesthetic).	**SS KGP2.1** **Features and Applications of Shapes** identify common shapes and objects by visual appearance only and use them purposefully in play **SS KGP2.2** **Pattern and Transformation** manipulate shapes or objects for a purpose, including matching and turning **SS KGP2.3** **Location** recognise basic direction and the position of their body in space.	**SS KGP3.1** **Features and Applications of Shapes** attend to features of shapes and show an awareness of the relationship between shape and function; describe how shapes and objects are alike and/or different **SS KGP3.2** **Pattern and Transformation** identify, describe and create simple repeating patterns by matching and turning shapes and use line symmetry within shapes **SS KGP3.3** **Location** follow and give oral directions based on everyday language of position and movement; read and create informal maps.
Measurement & Data Sense **Links** **EsseNTial Learnings:** Cr 1, Cr 2, Con 1, Con 2, Collaborative Learner **Learning Areas:** HPE, Science, SOSE, Technology and Design	**MDS KGP1** attend to, anticipate, respond to, initiate interaction with and explore sensory stimuli using their senses (auditory, visual, tactile, and/or kinaesthetic).	**MDS KGP2.1** **Estimating and Measuring** use language of size and simple comparative language when describing or comparing objects **MDS KGP2.2** **Using Relationships** use the language of measurement to describe simple relationships experienced in everyday activities **MDS KGP2.3** **Time** identify different time intervals, familiar times of the day/week/year and order events from own experience **MDS KGP2.4** **Chance** (no outcome at this level) **MDS KGP2.5** **Data Sense** sort and classify familiar objects and events using one criterion.	**MDS KGP3.1** **Estimating and Measuring** estimate, compare and describe length, capacity, area, volume and mass using direct comparison, and length, capacity and mass using informal units **MDS KGP3.2** **Using Relationships** describe relationships, including reciprocal relationships, in familiar contexts, using comparative measurement language **MDS KGP3.3** **Time** sequence events from own experience and identify significant times of the day/week/year **MDS KGP3.4** **Chance** recognise the element of chance in familiar activities and events **MDS KGP3.5** **Data Sense** classify, organise, record and use information, objects or pictures to answer simple questions.
Number Sense **Links** **EsseNTial Learnings:** Cr 1, Con 1, Con 2, Collaborative Learner **Learning Areas** All Learning Areas, depending on context.	**NS KGP1** attend to, anticipate, respond to, initiate interaction with and explore sensory stimuli using their senses (auditory, visual, tactile, and/or kinaesthetic).	**NS KGP2.1** **Numbers and Number Systems** recognise, name and use single digit numbers in simple, familiar contexts **NS KGP2.2** **Patterns and Relationships** begin to rote count and use some one-to-one correspondence; recognise and use simple patterns **NS KGP2.3** **Calculating** (no outcome at this level).	**NS KGP3.1** **Numbers and Number Systems** recognise, order and use 1 and 2 digit numbers in familiar contexts **NS KGP3.2** **Patterns and Relationships** count, matching counting to objects and describe simple number patterns in familiar contexts **NS KGP3.3** **Calculating** add and subtract small numbers when they occur in play/stories and draw pictures, use materials or calculators to record and solve these; state the value of some coins and use them in play situations.

Learners demonstrating evidence of **Band 1** *Year 3 Numeracy Benchmarks are in BLUE*	Learners demonstrating evidence of **Band 2** *Year 5 Numeracy Benchmarks are in BLUE*	**Strands and Links**
SS 1.1 **Features and Applications of Shapes** **recognise**, draw and make a **range of common two-dimensional (2D) shapes and three-dimensional (3D) objects and describe some of their features** and functions **using everyday language** **SS 1.2** **Pattern and Transformation** identify, describe, create and continue patterns and transformations including symmetrical designs **SS 1.3** **Location** **use simple grids, maps and plans to find familiar locations** and landmarks and describe these using positional language.	**SS 2.1** **Features and Applications of Shapes** **recognise, describe**, draw and make **a range of 2D shapes and 3D objects and use some geometric language to describe their features** and functions **SS 2.2** **Pattern and Transformation** identify, describe, **create and continue spatial and tiling patterns (tessellations)** including multiple lines of symmetry in 2D shapes and 3D objects **SS 2.3** **Location** **attend to** order and proximity when giving and following **directions for paths and locations** and **when reading** or creating **straightforward maps and plans.**	**Spatial Sense** **Links** **EsseNTial Learnings:** Cr 1, Con 1, Con 2, Collaborative Learner **Learning Areas:** The Arts, SOSE, Technology and Design
MDS 1.1 **Estimating and Measuring** estimate, **compare, describe and measure length**, area, **capacity**, volume **and mass using informal units**; estimate and measure length in cm and m **MDS 1.2** **Using Relationships** describe relationships between relevant attributes and units when comparing and measuring things **MDS 1.3** **Time** **read key times on digital and analogue clocks,** measure time intervals and **use calendars to locate information** **MDS 1.4** **Chance** **explain that some events are more likely or less likely to happen** **MDS 1.5** **Data Sense** **collect,** organise, **record** and use **data** to answer questions; **find and discuss information contained in simple graphs.**	**MDS 2.1** **Estimating and Measuring** **use common metric units to estimate, measure and compare length, capacity and mass; count units to measure area and volume** **MDS 2.2** **Using Relationships** explain and use the relationship between length and perimeter, measurement tools and accuracy of measurements **MDS 2.3** **Time** **use analogue and digital clocks to tell time accurately, use basic timetables and a range of calendars to find information** **MDS 2.4** **Chance** predict and **explain the comparative likelihood of familiar chance events** **MDS 2.5** **Data Sense** **collect,** organise, record, **display and interpret data in a variety of ways, including graphs and simple tables,** in order to answer questions.	**Measurement & Data Sense** **Links** **EsseNTial Learnings:** Cr 1, Cr 2, Con 1, Con 2, Collaborative Learner **Learning Areas:** HPE, Science, SOSE, Technology and Design
NS 1.1 **Numbers and Number Systems** apply place value knowledge to **compare, order** and use **2** and 3 **digit numbers,** and demonstrate awareness that these numbers belong to a larger system; use familiar common fractions in real situations **NS 1.2** **Patterns and Relationships** **identify and use patterns** and relationships **in 2 digit numbers**, based on repeated addition and subtraction **NS 1.3** **Calculating** **recall or work out basic addition and subtraction facts; decide which operation to use and whether to estimate, calculate mentally or use a calculator to add or subtract whole numbers in familiar contexts and solve multiplication and division problems concretely; recall the value of coins** and commonly used notes **and use them in practical situations.**	**NS 2.1** **Numbers and Number Systems** apply place value knowledge to **compare, order and use whole numbers** up to 5 digits **and decimal fractions to two places in familiar situations (including money and measurements),** and explain that these numbers belong to a larger system; **use, describe and record common fractions in a variety of ways** **NS 2.2** **Patterns and Relationships** **use number patterns and relationships involving addition, subtraction, multiplication and division** to describe, generate and continue sequences and simple statements of equality **NS 2.3** **Calculating** recall addition and subtraction facts and **recall, or work out mentally, multiplication facts; decide on the best way to calculate and accurately use any of the methods, including appropriate use of estimation.**	**Number Sense** **Links** **EsseNTial Learnings:** Cr 1, Cr 2, Con 1, Con 2, Collaborative Learner **Learning Areas** All Learning Areas, depending on context.

Strands and Links	Learners demonstrating evidence of **Band 3** *Year 7 Numeracy Benchmarks are in BLUE*

Spatial Sense

Links

EsseNTial Learnings: Cr 1, Con 1, Con 2, Collaborative Learner

Learning Areas: The Arts, SOSE, Technology and Design

SS 3.1
Features and Applications of Shapes
recognise different 2D representations of 3D objects including nets and cross-sections, and **use geometrical language to describe,** compare and classify **features** and functions **of 2D shapes and 3D objects when comparing, classifying,** drawing and constructing **these**

SS 3.2
Pattern and Transformation
create and describe patterns and designs based on symmetrical or tessellating figures

SS 3.3
Location
interpret and create **maps and plans** including giving and following directions for locations and paths, **using simple coordinate systems, scales and major compass points.**

Measurement & Data Sense

Links

EsseNTial Learnings: Cr 1, Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas: HPE, Science, SOSE, Technology and Design

MDS 3.1
Estimating and Measuring
choose appropriate units and use common measuring instruments to estimate, measure and compare length, capacity, mass and temperature

MDS 3.2
Using Relationships
explain and use the relationship between units of measurement and between length, area and volume when solving problems

MDS 3.3
Time
tell time accurately including 24 hour time, **read timetables, timelines and calendars and use relationships between common time units**

MDS 3.4
Chance
predict the chance of an event occurring**; explain chance based on simple experimental data**

MDS 3.5
Data Sense
collect and organise information in a variety of ways to answer questions posed by themselves/others and critically interpret data presented in a variety of ways.

Number Sense

Links

EsseNTial Learnings: Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas All Learning Areas, depending on context.

NS 3.1
Numbers and Number Systems
explain the recurring patterns in the Base 10 number system and **use** any **whole numbers, and decimals** to three **(two) decimal places (money/measurements); use, describe and record equivalences between common fractions, decimals, key percentages and simple ratios**

NS 3.2
Patterns and Relationships
use order of operations and number relationships to solve equations; **identify** and explain **the rule used to generate a number pattern**

NS 3.3
Calculating
accurately add, subtract, multiply and divide using a variety of strategies including fluent use of mental estimation and calculators.

Learners demonstrating evidence of
Band 4

Strands and Links

Space & Measurement

SM 4.1
Spatial Features
construct, analyse and generalise about shapes (circles, quadrilaterals, similar triangles) and objects (nets, models, simple polyhedra) using spatial properties including transformations

SM 4.2
Choosing and Using
select and use appropriate equipment and units to estimate/measure to a required degree of accuracy, distance, time, angle, area, volume and mass

SM 4.3
Relationships
use relationships between area and volume, time and distance, angles and lines, and Pythagoras' theorem; use and interpret scale, detailed plans, maps and other representations of objects

SM 4.4
Formulae
develop and apply formulae related to perimeter (circles), area (triangles, quadrilaterals, circles), and volume (right prism).

Links

EsseNTial Learnings:
Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas:
The Arts, SOSE, Technology and Design

Chance & Data

CD 4.1
Posing questions and collecting data
design and implement surveys and experiments to generate appropriate data to answer specific questions or address an identified issue, accounting for types of variables

CD 4.2
Experiments involving chance
devise and execute simple simulations to determine the related theoretical probabilities (sample space, randomness, probability)

CD 4.3
Presenting and Summarising Data
construct tables and graphs appropriate to the identified variables and analyse these to identify patterns and trends; use measures of central tendency and spread when describing data

CD 4.4
Interpreting Data
interpret and evaluate information presented in a range of tables and graphs, including comments on centre, spread and appropriateness of data collection methods.

Links

EsseNTial Learnings:
Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas:
HPE, Science, SOSE, Technology and Design

Number

N 4.1
Numbers and Number Systems
represent, compare, order and manipulate numbers including fractions, decimals, percentages, directed, ratios, surds, pi and indices

N 4.2
Patterns and Relationships
(no outcome at this level - refer to Algebra Strand)

N 4.3
Calculating
select, extend and apply facts, patterns and strategies including mental, written and electronic methods, for calculations involving rational numbers.

Links

EsseNTial Learnings:
Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas
All Learning Areas, depending on context.

Algebra

A 4.1
Global Features of Functions
sketch and interpret graphs of functions using global features, including intercept and slope

A 4.2
Linear Functions
derive, represent and interpret linear functions in electronic, tabular, symbolic and graphical form

A 4.5
Coordinate Geometry
plot and interpret coordinates on the Cartesian plane; calculate the slope between two given points

A 4.6
Equations and Inequalities
manipulate, construct and solve linear and other simple equations and inequations in a variety of contexts, defining the domain.

Links

EsseNTial Learnings:
Cr 2, Con 1, Con 2, Collaborative Learner

Strands and Links	Learners demonstrating evidence of Band 5
Space & Measurement **Links** **EsseNTial Learnings:** Cr 2, Con 1, Con 2, Collaborative Learner **Learning Areas:** The Arts, SOSE, Technology and Design	**SM 5.1** **Spatial Features** use simple properties (triangles, angle/line relationships) in developing logical arguments **SM 5.2** **Choosing and Using** choose and use appropriate equipment, units (including conversion between measurement systems), estimation, and validation methods in construction and when working with surface area and volume of prisms and pyramids **SM 5.3** **Relationships** use relationships between time and distance, angles and lines (including bearings), and right triangle trigonometry **SM 5.4** **Formulae** develop and apply formulae related to surface area and volume of right prism and pyramids.
Chance & Data **Links** **EsseNTial Learnings:** Cr 2, Con 1, Con 2, Collaborative Learner **Learning Areas:** HPE, Science, SOSE, Technology and Design	**CD 5.1** **Posing questions and collecting data** plan data collection, working individually and collaboratively, taking care in formulating questions and deciding how data should be organised before it is collected from a variety of appropriate sources **CD 5.2** **Experiments involving chance** use systematic strategies to calculate or estimate probabilities and use primary or secondary data to assign probabilities for one and two-stage events **CD 5.3** **Presenting and Summarising Data** organise data in diagrams and tables, with individually or collaboratively planned class intervals and display data to show frequency and spreads **CD 5.4** **Interpreting Data** interpret and critique own and published data, making adjustments and inferences where appropriate.
Number **Links** **EsseNTial Learnings:** Cr 2, Con 1, Con 2, Collaborative Learner **Learning Areas** All Learning Areas, depending on context.	**N 5.1** **Numbers and Number Systems** represent, compare, order and manipulate numbers including direct proportion, surds, fractional and directed indices, and scientific notation **N 5.3** **Calculating** select, extend and apply facts, patterns and strategies including mental, written and electronic methods, for calculations involving rational and irrational numbers.
Algebra **Links** **EsseNTial Learnings:** Cr 2, Con 1, Con 2, Collaborative Learner	**A 5.1** **Global Features of Functions** sketch and interpret graphs of functions using global features including intercepts, maxima and minima, transformation and shape; move fluently between representations **A 5.2** **Linear Functions** use linear functions to model real data using slope, intercepts and systems of equations **A 5.3** **Quadratic Functions** identify, represent and interpret key features of quadratic functions in electronic, tabular, symbolic and graphical form **A 5.5** **Coordinate Geometry** calculate and interpret perpendicular and parallel gradients, and calculate midpoint and distance **A 5.6** **Equations and Inequalities** model, construct and solve linear and quadratic equations and inequations, and manipulate complex formulae, in various contexts.

Learners demonstrating evidence of
Beyond Band 5

Strands and Links

Space & Measurement

SM 5+.1
Spatial Features
use a range of geometric properties in formal logical processes, including deductive proofs

SM 5+.2
Choosing and Using
choose and use appropriate equipment, units, estimation and validation methods when constructing and working with surface area and volume of prisms, pyramids, cones and spheres; identify instrument error

SM 5+.3
Relationships
use relationships between time and distance, angles and lines (including bearings), and right triangle trigonometry and circle theorems

SM 5+.4
Formulae
develop and apply formulae for surface area and volume of pyramids, cones and spheres.

Links

EsseNTial Learnings:
Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas:
The Arts, SOSE, Technology and Design

Chance & Data

CD 5+.1
Posing questions and collecting data
plan experiments, simulations and surveys, collaboratively and independently, considering the appropriateness and quality of observations, the suitability of samples or populations

CD 5+.2
Experiments involving chance
estimate and calculate probabilities, proportions, means and medians based on primary and secondary data collection and assign probabilities using complementarity and independence

CD 5+.3
Presenting and Summarising Data
compare, choose and use methods of organisation to suit the type of data and the questions asked; display and summarise data to compare data sets and to show relationships within a data set

CD 5+.4
Interpreting Data
interpret collected and published data from tables, diagrams, plots, graphs, prose and databases to make comparisons, describe relationships and construct arguments.

Links

EsseNTial Learnings:
Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas:
HPE, Science, SOSE, Technology and Design

Number

N 5+.1
Numbers and Number Systems
represent, compare, order and manipulate numbers including inverse proportion, surds, indices and logarithms

N 5+.3
Calculating
appropriately select and apply mental, written or electronic strategies for calculations involving surds, indices and logarithms.

Links

EsseNTial Learnings:
Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas
All Areas, depending on context.

Algebra

A 5+.3
Quadratic Functions
use quadratic functions to model real data using symmetry, critical points and intercepts

A 5+.4
Exponential Functions
identify, represent and interpret key features of exponential and logarithmic functions in electronic, tabular, symbolic and graphical form

A 5+.6
Equations and Inequalities
model, construct, manipulate and solve exponential equations in a variety of contexts.

Links

EsseNTial Learnings:
Cr 2, Con 1, Con 2, Collaborative Learner

Spatial Sense

Links

Essential Learnings: Refer to specific links listed below.

Learning Areas: Refer to specific links listed below.

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 1**

SS KGP1 attend to, anticipate, respond to, initiate interaction with and explore sensory stimuli using their senses (auditory, visual, tactile, and/or kinaesthetic).

INDICATORS

Learners demonstrating evidence of **Key Growth Point 1** for example

Features and Applications of Shapes

- respond to familiar objects and people **[SOSE - Soc]**
- reach or look for a desired object
- explore objects with senses.

Pattern and Transformation [HPE-PA]

- fold paper in imitation **[Arts-SkP] [T&D-DPC]**
- demonstrate object permanence, eg look for things where last seen, move head to get a better view
- transfer objects from one hand to another
- bring hands together to grasp an object
- make certain movements for a purpose, eg repeat an action.

Location [Con 2]

- find own classroom on arrival
- indicate awareness of being moved in space, eg from wheelchair to floor, from room to room
- locate key areas within their environment, eg toilet **[SOSE - Env]**
- indicate an awareness of familiar places through outward response.

Spatial Sense

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 2**

SS KGP2.1 Features and Applications of Shapes
identify common shapes and objects by visual appearance only and use them purposefully in play

SS KGP2.2 Pattern and Transformation
manipulate shapes or objects for a purpose, including matching and turning

SS KGP2.3 Location
recognise basic direction and the position of their body in space.

Links

EsseNTial Learnings: Cr 1, Con 1, Con 2, Collaborative Learner

Learning Areas: Technology and Design, The Arts

Perspectives: Learning Technology

INDICATORS

Learners demonstrating evidence of **Key Growth Point 2** for example

Features and Applications of Shapes

- name, point to or indicate some simple, common shapes, eg square, triangle, circle
- experiment with sorting and matching during play, eg put all little shapes together
- match identical objects
- with guidance, use commercial software related to the classification, naming and matching of simple shapes and colours
- use appropriate materials to build something, eg blocks to build a tower **[T&D-DPC]**
- use appropriate common objects in play, eg use a large box as a fridge
- return play material to the right place **[SOSE-Soc] [LS]**
- watch and talk about different shapes being drawn in the sand by a storyteller .

Pattern and Transformation [Cr 2] [T&D-DPC]

- manipulate objects for a purpose **[Cr 3]**, eg
  - stack blocks
  - put pegs into and pull pegs out of a pegboard
  - turn a shape to fit it into the right hole in a puzzle
  - stack turtle eggs, arrange bush fruits ready for sharing etc
- use commercial software to manipulate and re-position simple shapes and colours, with guidance, eg Kidpix
- use materials to form shapes, eg biscuit cutters to make biscuits **[Arts - SkP]**
- fit small number of shapes together with help of a template, eg jigsaw with up to five pieces.

Location [HPE-PA]

- respond to instructions when occupying a space shared by others e.g. stand next to your partner, make groups of three, all the 'dingoes' move forward **[Col 3] [LS] [LS]**
- arrange objects to suit a purpose, eg put chairs in line to represent a bus; move desks to make room for another activity
- locate certain rooms in the school **[SOSE-Env] [LS]**
- crawl or climb over, under, on and off a given object
- respond to request for changing positions in a game, eg put hand up, sit down **[Col 2]**
- follow a path or line marked on the ground
- follow directions for steps in dance movements .

Spatial Sense

Links

EsseNTial Learnings: Cr 1, Con 1, Con 2, Collaborative Learner

Learning Areas: Technology and Design, The Arts; Perspectives: Literacy, Learning Technology

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 3**

SS KGP3.1 Features and Applications of Shapes
attend to features of shapes and show an awareness of the relationship between shape and function; describe how shapes and objects are alike and/or different

SS KGP3.2 Pattern and Transformation
identify, describe and create simple repeating patterns by matching and turning shapes and use line symmetry within shapes

SS KGP3.3 Location
follow and give oral directions based on everyday language of position and movement; read and create informal maps.

INDICATORS

Learners demonstrating evidence of **Key Growth Point 3** for example

Features and Applications of Shapes [T&D-DPC]

- attend to important shape features when copying, drawing a picture or building an object, eg choose a triangle for the roof on a house, circular pieces for wheels **[Arts-SkP]**
- draw or make a thing from an oral description which involves spatial language and implies shape, eg use play dough to make a long snake **[Lit-LS]**
- recognise and describe (approximations of) common shapes in everyday things, eg wheels as circles, boxes etc having squares/rectangles **[Lit-LS] [Arts-SkP]**
- construct models, eg use sand to make a castle
- compare and sort objects according to size, features or function **[LS]**, eg
  - stack plates, sort cutlery into sections of drawer; stack food items appropriately in cupboards
  - organise and maintain storage areas within the classroom; plan what items will fit into appropriate spaces
- respond to and begin to use everyday language to describe shape and function, eg flat, straight, curved, side, round, rolls, slides, stacks **[Lit-LS]**
- talk about symbols in paintings as being similar to something, eg straight like a spear, round like a waterhole .

Pattern and Transformation [Arts-CrA] [Arts-SkP]

- use a fold line to produce symmetrical pictures (by painting, folding, cutting, tracing, or freehand) and describe the result **[T&D-DPC]**
- manipulate shapes to show that they match by turning and placing one exactly on top of the other **[Cr 2]**
- fit shapes and objects together based on shape and orientation, eg jigsaw puzzles without templates of more than 5 pieces
- invent their own repeating pattern with a range of materials, **[Num-NS]** eg use patterns blocks and/or coloured tiles to make a three colour repeating pattern.

Location [Lit-LS] [SOSE-Env]

- draw pictures or make things which illustrate everyday language of position **[T&D-Pr] [Arts-SkP]**, eg
  - draw a picture showing the snake under the house
  - participate in 'Follow the Leader', 'Simon Says' or circle games involving position
- respond appropriately to everyday language of position and movement **[HPE-PA]**, eg
  - under, behind, in front of, in, on, near, on top of, around
- use some everyday language of position and movement **[HPE-PA]**, eg
  - 'The book is under the desk.' 'The bird is flying around the tree.'
- draw or make a simple story map, paying attention to order of events/pictures [Lit-W], eg make models, draw 'mud maps', draw a simple map showing traditional land ownership of local area .

Year 3 National Numeracy Benchmarks are 'blue' within this band

Spatial Sense

Year 5 National Numeracy Benchmarks are in 'italics' within this band

OUTCOMES

Learners demonstrating evidence of **Band 1**

SS 1.1 Features and Applications of Shapes
recognise, draw and make **a range of common two-dimensional (2D) shapes and three-dimensional (3D) objects and describe some of their features** and functions **using everyday language**

SS 1.2 Pattern and Transformation
identify, describe, create and continue patterns and transformations including symmetrical designs

SS 1.3 Location
use simple grids, maps and plans to find familiar locations and landmarks and describe these using positional language.

Links

EsseNTial Learnings: Cr 1, Con 1, Con 2, Collaborative Learner

Learning Areas: Technology and Design, The Arts; Perspectives: Literacy

INDICATORS

Learners demonstrating evidence of **Band 1** for example

Features and Applications of Shapes [T&D-DPC]

- **recognise, describe** and draw **common 2D shapes/3D objects in familiar contexts [Arts-SkP]**, eg
  - draw and **name specific 2D shapes: triangle, square, circle, rectangle**
  - **name 3D objects: cube, pyramid**
  - **recognise 2D shapes as part of some 3D objects**
- **use appropriate informal language, (eg flat, round, corner, side, curved, straight) to describe characteristics of common 2D shapes/3D objects, eg 'This ball is round, it has no corners and it will roll easily.' [Lit-LS]**
- **describe and distinguish basic properties of common 2D shapes/3D objects, [Arts-Res]** eg
  - **'Without the handle, this mug is the like shape of the drink can.'**
  - **'Things like cans, tubes and rolls of tape are all the same kind of thing and they will roll.'**
- sort things according to simple spatial properties, eg number of sides, shape of faces
- use nets provided to make 3D objects, eg gift box/basket
- make things that will meet certain criteria, eg will roll, stack, stand up by itself
- select materials/methods to achieve what they have in mind, eg select and arrange long, wide planks to build a bridge to cross the room without touching the ground
- describe shapes in different Indigenous paintings, eg dot paintings, diamond shapes, cross-hatching.

Pattern and Transformation

- *recognise* an obvious *line of symmetry in 2D shapes, eg fold a butterfly drawing to show line symmetry*
- make symmetrical pictures and designs using a variety of means, eg flipping, drawing around templates **[Arts-CrA] [Arts-SkP]**
- use shapes or objects to create a recognisable pattern for decorative purposes and describe the pattern **[Arts-CrA] [Con 2] [Cr 3] [LT]**
- **recognise** describe **and continue patterns or transformations involving 2D shapes and 3D objects, eg a pattern starting ● ◆ ❍ ● ◆ or a pattern comprising a can, ball, cube**
- **recognise and describe a single flip or slide of a 2D shape, eg use flips or slides to see whether shapes are identical.**

Location [SOSE-Env]

- **recognise and use common positional and directional language in relation to simple grids, maps and plans [Lit-LS]**, eg
  - **place a cross between the tree and the house**
  - **shade the tree at B3 on the grid**
  - **follow directions for how to get to the school on a map "walk across the bridge and past the shop then turn the corner at the church"**
  - pay attention to order and proximity when creating a story map based on a familiar book **[Lit-RV]**
  - make a map of location of Indigenous institutions in local area, eg ATSIC, Land Council
- follow and give adequate directions including 'between' to find an object, eg find treasure that was hidden between the bins but past the tap **[HPE-PA]**
- find own way around large but familiar environment, eg shopping centre, large school **[LS]**
- set a table appropriately **[LS]**
- use vacuum cleaner/hose with appropriate directionality. **[LS]**

Year 5 National Numeracy Benchmarks are 'blue' within this band

Spatial Sense

Year 7 National Numeracy Benchmarks are in 'italics' within this band

Links

EsseNTial Learnings: Cr 1, Con 1, Con 2, Collaborative Learner

Learning Areas: Technology and Design, The Arts

Perspectives: Literacy, Learning Technology

OUTCOMES

Learners demonstrating evidence of **Band 2**

SS 2.1 Features and Applications of Shapes
recognise, describe, draw and make **a range of 2D shapes and 3D objects and use some geometric language to describe their features** and functions

SS 2.2 Pattern and Transformation
identify, describe, **create and continue spatial and tiling patterns (tessellations)** including multiple lines of symmetry in 2D shapes and 3D objects

SS 2.3 Location
attend to order and proximity when giving and following **directions for paths and locations** and **when reading** or creating **straightforward maps and plans.**

INDICATORS

Learners demonstrating evidence of **Band 2** for example

Features and Applications of Shapes [Lit-LS]

- **recognise, describe and compare common 2D shapes/3D objects and their features in familiar contexts [T&D-DPC]**, eg
  - **given descriptions or drawings, name specific shapes: pentagons, hexagons,** Hong Bao (Chinese red packets)
  - **name specific objects when given real objects or realistic drawings, eg cylinders, cones**, cubes, pyramids, **rectangular prisms**
  - **state 'These 3D objects are both pyramids but one has a triangular base and the other has a square base.'; say what makes a cone and a cylinder different**
- **use** both everyday and **geometrical language (eg angle, side, edge, face, base, surface), to describe** and compare **features** and functions **of common shapes/objects, eg state that if the object has a curved surface and no straight edges, it might be a sphere or cylinder**
- match standard geometric models with realistic drawings and conventional diagrams
- describe and represent their visualisations of cross-sections of familiar objects without cutting, eg carrots, cubes **[T&D-DPC] [Arts-SkP]**
- predict which pentominoes would make nets for open boxes and test predictions by folding
- pay attention to shape and placement of parts when matching, making and copying objects, eg make solid objects with clay or skeletal models with straws **[T&D-DPC] [Arts-SkP]**
- justify their choice of shapes or objects in terms of function and/or design **[Cr 3] [T&D-DPC] [Arts-Res]**
- investigate designs in Indigenous paintings, and body designs, eg diamonds in northeast Arnhem Land Yirritja paintings.

Pattern and Transformation [T&D-DPC]

- *identify multiple lines of symmetry in 2D shapes* and 3D objects **[Arts-SkP]**, eg determine the lines of symmetry within letters of the alphabet, divide a cube made out of play dough to demonstrate planes of symmetry
- **identify and continue repetitions of a shape embedded in patterns or tessellations, eg continue a 'brick wall' pattern**, Japanese Tatami Mats
- **draw the result of a single flip, slide or turn of a shape [Arts-SkP]**
- given multiple copies of a figure, investigate and explain if it will tessellate.

Location [SOSE-Env]

- **follow/give directions based on order, proximity, pathways and routes [Lit-LS]**, eg
  - put a cross to show a basketball ring if it is between the taps and the office but closer to the office; say 'to get to the bridge, turn left at the phone box & keep going 'til you reach a bus stop.'
- **locate specific objects using a key or legend, eg find and interpret the symbol in the square D5 on the map**
- locate Indigenous communities on a map of the NT, and link by language groups
- *use grids and basic North, South, East, West compass points to locate places on a map, eg identify familiar places using a page of the local street directory*
- *attend to proximity and 'bird's eye' view when making maps of familiar places.*

Spatial Sense

Year 7 National Numeracy Benchmarks are 'blue' within this band

OUTCOMES

Learners demonstrating evidence of **Band 3**

SS 3.1 Features and Applications of Shapes
recognise different 2D representations of 3D objects, including nets and cross-sections, and **use geometrical language to describe**, compare and classify **features** and functions **of 2D shapes and 3D objects when comparing, classifying**, drawing and constructing **these**

SS 3.2 Pattern and Transformation
create and describe patterns and designs based on symmetrical or tessellating figures

SS 3.3 Location
interpret and create **maps and plans** including giving and following directions for locations and paths, **using simple coordinate systems, scales and major compass points.**

Links

EsseNTial Learnings: Cr 1, Collaborative Learner ,Con 1, Con 2

Learning Areas: Technology and Design, The Arts

Perspectives: Literacy

INDICATORS

Learners demonstrating evidence of **Band 3** for example

Features and Applications of Shapes [T&D-DPC]

- **recognise, and use appropriate geometrical language (eg diagonal, right angle, parallel, perimeter, circumference, degrees**, faces, edges, vertices) **to describe common 2D shapes/3D objects and representations of these, including simple nets, [Lit-LS] eg**
  - **say 'The face of this tile is a hexagon and this one is an octagon.'; 'A Toblerone box is a triangular prism as it has 2 triangles & 3 rectangles as faces.'; 'This net would form a cube.'**
  - **select the correct view of an object from above or behind**
- **describe and distinguish essential** geometric and functional **features of 2D shapes/3D objects to classify, compare and identify relationships between them [Lit-LS], eg**
  - **say 'This is an equilateral triangle because all sides are equal.'; 'I could cut this rectangle into two right angled triangles.'**; 'Rectangular priSM are used for packaging because they stack well and fit together and leave no spaces.'; 'Triangles are used in house frames because they are rigid.'
- **recognise basic angles, describing them as corners of shapes and as degrees of rotation, eg 'The roller-blader did a 360 - a full turn' ,'The corners of a rectangle are right angles, that's 90.º'**
- match objects with a range of 2D representations of them, eg photo, isometric drawing, multiple views
- select suitable lengths to make a skeletal model the same size as a given object
- design nets to construct a range of simple 3D objects for a specific purpose, eg a gift box, 'chops' - Chinese Personal Seals **[SOSE]**
- draw recognisable 3D objects using some conventions of perspective or oblique drawing **[Arts-SkP].**

Pattern and Transformation [T&D-DPC]

- **identify, describe and use combinations of transformations, eg flip (reflection), slide (translation) and turn (rotation) to create designs, eg**
  - **identify repetitions of identical shapes in a fabric pattern**
  - **say 'To move a shape from < to ^ you need a right turn of 90º.'**
  - **create a border pattern involving a sequence of flips or rotations**
  - identify symmetries present in Indigenous art forms, eg basket weaving
- reproduce folds and cuts used to make complex symmetrical patterns by visualising possibilities, eg a paper snowflake, Logo **[Arts-SkP]**
- decide whether a figure will tessellate and, given a template, explain the sequence of movements required to achieve tessellation
- generate sequences of simple shapes or objects that double or triple in dimensions
- create a simple tessellation for a particular purpose, eg paving, tiling.

Location [SOSE-Env]

- **identify and describe locations/routes using (simple) coordinate maps , eg**
  - **find a street that runs from B3 to A4 in a street directory of an unfamiliar area**
  - **use a map to find the town that is on the East of the highway and North of the creek**
- **use proximity and a sense of scale when drawing (simple) plans of familiar locations, eg**
  - **draw a sketch plan of the route from school to home**
  - **draw an outline of a basketball court on centimetre grid paper using a scale of 1cm:1m**
- make a simple scale drawing of a piece of furniture and explain the scale used **[T&D-DPC]**
- use intermediate compass points to give directions, eg describe movements on isometric dot paper using NE, NW, SE, SW
- draw aerial views/maps of the local area and label with traditional Indigenous languages areas
- study the relationship between artwork depicting a landscape and the landscape it represents .

Space and Measurement

Links

EsseNTial Learnings: Cr 2, Con 1, Con 2, Collaborative Learner

Learning Areas: Technology and Design, The Arts

Perspectives: Literacy, Learning Technology

OUTCOMES

Learners demonstrating evidence of **Band 4** for example

SM 4.1 Spatial Features
construct, analyse and generalise about shapes (circles, quadrilaterals, and similar triangles) and objects (nets, models, simple polyhedra) using spatial properties including transformations

SM 4.2 Choosing and Using
select and use appropriate equipment and units to estimate/measure to a required degree of accuracy, distance, time, angle, area, volume and mass

SM 4.3 Relationships
use relationships between area and volume, time and distance, angles and lines, and Pythagoras' theorem; use and interpret scale, detailed plans, maps and other representations of objects

SM 4.4 Formulae
develop and apply formulae related to perimeter (circles), area (triangles, quadrilaterals, circles), and volume (right prisms).

INDICATORS

Learners demonstrating evidence of **Band 4** for example

Spatial Features

- describe properties of and between classes of geometric shapes/objects eg 'A square is a special case of a rhombus, but the reverse isn't true.' **[Lit-LS]**
- investigate the relationship between the angle sum and the number of sides of polygons
- develop and use geometric construction techniques to verify geometric properties, eg opposite angles of a parallelogram being equal
- through measurement and geometric construction, list and classify the properties of quadrilaterals
- demonstrate geometric generalisations with the aid of interactive geometry systems, eg diagonals of a rhombus are perpendicular bisectors **[LT-R]**
- construct nets to make a given 3D model to specification, eg a cube with a capacity of 600mL
- create a realistic perspective drawing of simple compound objects using basic conventions
- represent and describe reflections, translations or rotations using pen, paper, tools and/or Cabri GeometryTM or Geometers' SketchpadTM **[Lit-LS] [LT-R]**
- use similarity relationships between triangles to find distances and heights in inaccessible situations
- develop and apply methods, including electronic, for enlarging, reducing, repeating and moving angles, shapes and objects, eg scale drawings and models, maps, textiles patterns, logo design **[T&D-De].**

Choosing and Using [Sci-CC]

- explain that choice of unit depends on purpose not the size of an object being measured, eg a bridge may be measured in m. to estimate paint needed but must be measured to the mm for engineering purposes
- use common metric prefixes and appropriate derived units to specify rates, eg cm/wk for plant growth.

Relationships [SOSE-Env]

- find and use ways of accurately measuring objects that are too big or too small for the available equipment, eg estimate the thickness of a single sheet of paper by measuring the thickness of a ream.
- explore the relationship between scale and area, eg construct two squares, one with half the area of another
- use spreadsheet to develop a list of Pythagorean triples and identify number patterns in the list **[LT-R]**
- plan and execute simple navigational routes using true bearings, distances and Pythagoras
- apply the relationship between distance and time, eg given a driver's log book, calculate and represent speed for given time intervals; develop a travel plan using a range of timetables, time zones, locations
- investigate the relationship between perimeter and area, and surface area and volume, eg maximum prism volume from a given rectangular sheet of metal
- develop deductive arguments using geometric properties such as: co-interior, alternate, straight line complementary, and vertically opposite angles; midpoints; and side-lengths, eg the sum of the co-interior angles equals the exterior angle
- locate positions on maps using latitude/longitude; explain coordinates represented on GPS navigational equipment, eg use maritime maps/GPS coordinates to show fishing locations or distances from given points
- read and interpret detailed plans, blueprints or elevations (orthogonal views) to visualise/construct real objects, eg use isometric drawings to make 3D objects using cubes
- enlarge/reduce shapes using projections and explain the effect of scale on lengths and areas of the image
- describe how 'betweeness', order, orientation, proximity and scale are or are not represented on a schematic map such as those associated with Dreaming tracks .

Formulae [Num-A]

- develop and apply a formula for area of a triangle using grid paper or electronic methods **[LT-R]**
- calculate perimeters, areas and volumes of common 2D shapes and simple priSM including fractional dimensions, eg calculate the area of water coverage for a pop-up sprinkler, calculate the number of revolutions a bike wheel of diameter 70cm makes to travel a kilometre
- choose and apply appropriate formulae including Pythagoras's theorem to answer simple questions in context, eg application of fertiliser to a composite-shaped garden, height of trees.

Space and Measurement

OUTCOMES

Learners demonstrating evidence of **Band 5**

SM 5.1 Spatial Features
use simple properties (triangles, angle/line relationships) in developing logical arguments

SM 5.2 Choosing and Using
choose and use appropriate equipment, units, (including conversion between measurement systems), estimation, and validation methods in construction and when working with surface area and volume of prism and pyramids

SM 5.3 Relationships
use relationships between time and distance, angles and lines (including bearings), and right triangle trigonometry

SM 5.4 Formulae
develop and apply formulae related to surface area and volume of right prisms and pyramids.

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas: Technology and Design

Perspectives: Learning Technology

INDICATORS

Learners demonstrating evidence of **Band 5** for example

Spatial Features

- use mathematical properties to check the accuracy of constructed figures, eg check the lengths of diagonals of a rectangle
- explore and produce shapes to meet a geometric constraint, **[T&D-Pr]** eg
  - construct a triangle with 2 sides 5cm and 7cm and the included angle as 60 degrees;
  - investigate and report on all possible quadrilaterals that have one pair of parallel sides
- identify properties of similar triangles and use them to solve problems, eg test and revise descriptions of types of triangles by searching for counter-examples
- construct accurate diagrams showing circle patterns and relationships **[T&D-Pr]**
- describe the features of various classes of quadrilaterals and show inclusivity relationships, eg produce a branching tree showing the relationship between quadrilaterals, trapezia **[Lit-LS] .**

Choosing and Using [T&D]

- use a ruler, protractor, pairs of compasses and a selection of other tools, including interactive geometry systems, to draw parallels and perpendiculars and to copy lines and angles
- make a model based on specifications provided in isometric, oblique or perspective drawings/plans
- construct figures including triangles, quadrilaterals, circles and ellipses for which a diagram, dimensions or both have been provided, eg a regular hexagon
- develop generalised nets for 3D objects using interactive geometry systems, eg drag-resistant models **[LT-R]**
- accurately carry out a specified translation, rotation or reflection using coordinates, tracing paper, or geometric equipment
- draw accurate scale diagrams to solve geometric problems including missing sides and similarity
- unprompted, elect to estimate rather than measure in situations in which estimation is sensible and convenient, justifying this choice **[HPE]**
- check to ensure that consistent units are used for computational purposes and express solutions in correct units, eg when calculating average mass, convert all measurements to grams **[HPE] [Sci] [SOSE]**
- combine published information with own measurements in solving a practical problem. **[HPE] [Sci] [SOSE]**

Relationships

- identify congruent, supplementary and complementary angles and use angle relationships in intersecting, parallel and perpendicular lines and triangles to find other angles **[LT]**
- calculate time and elapsed time, taking into account daylight savings and time zones, eg use an airline timetable to calculate flying time and local departure and arrival times for a return trip Darwin-Sydney **[SOSE]**
- use conversion graphs to find speed in different units, eg m/s to km/h **[HPE] [Sci] [SOSE]**
- use Sine, Cosine and Tangent ratios to find missing sides and angles in right triangles, eg angles of elevation/depression and bearings.

Formulae [Num-A]

- select suitable formulae and measurements to calculate the area of rectangles, triangles, parallelograms, trapezia and circles and the surface area and volume of priSM, cylinders and pyramids, including using electronic methods **[LT-R]**
- unprompted, use Pythagoras's theorem appropriately to solve problems, eg finding distances from a map in orienteering
- use appropriate formulae to directly and indirectly solve problems, eg speed = distance/time **[HPE] [Sci] [SOSE].**

Space and Measurement

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas: Technology and Design

Perspectives: Learning Technology

OUTCOMES

Learners demonstrating evidence of **Beyond Band 5**

SM 5+.1 Spatial Features
use a range of geometric properties in formal logical processes, including deductive proofs

SM 5+.2 Choosing and Using
choose and use appropriate equipment, units, estimation and validation methods when constructing and working with surface area and volume of prisms, pyramids, cones and spheres; identify instrument error

SM 5+.3 Relationships
use relationships between time and distance, angles and lines (including bearings), and right triangle trigonometry and circle theorems

SM 5+.4 Formulae
develop and apply formulae for surface area and volume of pyramids, cones and spheres.

INDICATORS

Learners demonstrating evidence of **Beyond Band 5** for example

Spatial Features

- develop and use conventional geometric language to explain methods for finding the centre of a circle in terms of properties of chords and tangents, eg for compass constructions and paper folding
- apply properties of special quadrilaterals such as rhombus and parallelogram to solve problems, eg use diagonals bisecting at right angles in a rhombus to enable Pythagoras's theorem to be used
- produce chains of arguments to prove statements based on a given set of geometric axioms or assumptions, including traditional Euclidean statements, eg prove that an angle in a semi-circle is a right angle, proof of similarity of triangles
- explain that translated, rotated or reflected figures and objects are similar and apply this to mathematical and practical problems, eg use properties of reflection to show that the base angles of an isosceles triangle are congruent
- develop deductive proofs involving triangles and parallelograms using geometric theorems.

Choosing and Using

- apply properties of chords, tangents and angles in circles to construction problems, eg use a variety of methods to construct a tangent from a point to a circle, find the largest square containing a given circle
- choose materials and geometric properties of circles to carry out practical tasks, eg make a pattern of pieces for a circular skirt, find the centre of a circular garden to place a sundial **[T&D-De]**
- construct figures and objects according to specifications and solve problems involving congruence and similarity, including using interactive geometry systems **[LT-R]**
- discuss expected errors, making and justifying decisions about the acceptable level of uncertainty in different contexts, eg upper and lower limits on a tonne of sand as opposed to a medicine dosage **[Sci]**
- describe the compounding effect of errors in calculations involving measurements, eg when ordering concrete for a slab which is 0.01m x 4.3m x 2.1m
- investigate and explain how an instrument based on similarity works, eg clinometer, binoculars, microscope
- select and apply appropriate scales for making scale drawings and models, eg find and apply the similarity or scale factor that relates two figures or objects. **[Sci] [SOSE] [T&D-Pr].**

Relationships

- explain relationships in figures involving circles, eg why an angle in a semi-circle is a right angle
- construct the locus of an object moving according to a rule expressed in conventional mathematical language, eg the locus of points such that the sum of the distance from points A and B is 12cm
- investigate and describe the features of various conic sections
- develop and apply relationships, obeying constraints, including parallel, perpendicular and intersecting lines, triangles, quadrilaterals and circles using interactive geometry systems
- use the effect of scaling the linear dimensions on the perimeter, area and volumes of shapes to solve problems, eg use knowledge that if the radius of a circle is doubled, then the area is quadrupled to compare the cost of 20cm and 40cm pizzas without calculation **[Sci] [SOSE] [T&D-Pr]**
- apply trigonometric ratios to solve problems involving triangles that are not right-angled.

Formulae [Num-A]

- develop and apply formulae to find the surface area and volume of spheres, including indirect use, eg to calculate the radius of a cylinder from information about its height and volume
- use trigonometry to accurately calculate heights in inaccessible situations
- justify their solution to measurement problems, eg draw on geometry to justify that the diagonal of the square inscribed in a circle is a diameter
- represent solutions to area, surface area, perimeter and volume problems electronically **[LT-R].**

Measurement and Data Sense

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 1**

MDS KGP1 attend to, anticipate, respond to, initiate interaction with and explore sensory stimuli using their senses (auditory, visual, tactile, and/or kinaesthetic).

INDICATORS

Learners demonstrating evidence of **Key Growth Point 1** for example

Estimating and Measuring

- pour from one container to another **[LS]**
- build, nest, stack and construct with different materials during play **[T&D-DPC]**
- select or indicate a big/ small object when asked
- identify cups and spoons as being used for filling or measuring during free-play or cooking **[LS].**

Time [SOSE-Env] [LS]

- use senses to identify times of day, eg smell food cooking at lunchtime
- indicate awareness of environmental cues that indicate parts of routines, eg lunchtime and end of the school day
- recognise and respond to cues that signal the beginning or end of an activity, eg a bell.

Data Sense [Col 3] [SOSE-Soc]

- indicate which group or class they belong to
- demonstrate awareness of self as part of group in relation to others in group **[HPE]**
- match identical objects.

Links

Essential Learnings: Refer to specific links listed here.

Learning Areas: Refer to specific links listed here.

Measurement and Data Sense

Links

EsseNTial Learnings: Cr 1, Cr 2, Collaborative Learner, Con 1, Con 2

Perspectives: Literacy - Listening and Speaking

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 2**

MDS KGP2.1 Estimating and Measuring
use language of size and simple comparative language when describing or comparing objects

MDS KGP2.2 Using Relationships
use the language of measurement to describe simple relationships experienced in everyday activities

MDS KGP2.3 Time
identify different time intervals, familiar times of the day/week/year and order events from own experience

MDS KGP2.4 Chance - no outcome at this level

MDS KGP2.5 Data Sense
sort and classify familiar objects and events using one criterion.

INDICATORS

Learners demonstrating evidence of **Key Growth Point 2** for example

Estimating and Measuring

- select a big/small object when asked, eg a box or plate
- sort objects into groups on the basis of big/small, long/short
- use everyday language or gestures to describe attributes of objects, including size, eg big, small, heavy, more, tall, full, empty
- (length) select a long/short object when asked, eg a ruler
- (length) select the longer/shorter object when asked, eg comparing length of a pencil and ruler
- (capacity) cooperate in activities involving cooking **[HPE-HP] [Col 1] [Col 3]**, eg mix 3 cups of flour with 1 cup of milk
- (mass) comment on or give indication of weight when lifting objects.

Using Relationships

- selects something that might fit in a given space.
- states, 'the box was too small', 'we need a longer rope'.

Time

- respond appropriately to everyday language of time eg lunchtime, recess, later, next, yesterday
- distinguish between day and night, morning and afternoon, wet and dry season, (summer/winter)
- respond to beat and rhythm in music and movement, eg clapping and stepping in time to music, playing instruments **[Arts-Res]**
- refer to time of day and day of week, or time of year in an informal way eg, before I go to bed, early in the morning, in the holidays, the season when different bush foods are ready to pick **[SOSE-Soc]**
- choose a picture to complete a sequence depicting a familiar event eg inflating a balloon, making a painting, packing toys away.

Data Sense

- identify a group to which they belong in order to participate in an activity, eg language groups, skin groups **[SOSE-Soc]**
- separate a given set of objects from a collection using one obvious criteria, eg separate the buttons from a collection of buttons and other objects
- sort objects according to one attribute eg put all the big teddies together, sort the pattern blocks by colour.

Measurement and Data Sense

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 3**

MDS KGP3.1 **Estimating and Measuring**
estimate, compare and describe length, capacity, area, volume and mass using direct comparison and length, capacity and mass using informal units

MDS KGP3.2 **Using Relationships**
describe relationships, including reciprocal relationships, in familiar contexts, using comparative measurement language

MDS KGP3.3 **Time**
sequence events from own experience and identify significant times of the day/week/year

MDS KGP3.4 **Chance**
recognise the element of chance in familiar activities and events

MDS KGP3.5 **Data Sense**
classify, organise, record and use information, objects or pictures to answer simple questions.

Links

EsseNTial Learnings: Cr 1, Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas: Refer to specific links listed below.

Perspectives: Literacy - Listening and Speaking

INDICATORS

Learners demonstrating evidence of **Key Growth Point 3** for example

Estimating and Measuring

- use and respond to some everyday language of approximation, eg about, almost
- make something from an oral description relating to size, eg a long/thin snake, a tall/thin building **[T&D-Pr]**
- (length) respond to, and use, comparative language of length, eg longer than, taller than, shorter than
- (length) select something longer than/shorter than/the same length as a given object
- (length) line up one end of objects to make a direct comparison
- (capacity) respond to a request to find a container that will 'hold more', 'hold less' or 'about the same' as a given container
- (mass) respond to, and use, comparative language of mass, eg heavier than, lighter than, too heavy
- (length) guess how many times a unit will fit along an object, eg 'How many pens will 'fit along' the desk?'
- guess then count informal units of length (hand-spans/paces), capacity (cups/spoonfuls) or mass (marbles/bolts) to match/fill /balance an object **[Sci-WS].**

Using Relationships

- (area and volume) respond to a request to find something bigger or smaller than a given object, eg
  - a tea-towel, smaller than a large envelope
  - (volume) bigger than a shoe box, smaller than a fridge
- (mass) find objects that are clearly heavier than or lighter than a given object by hefting
- make comparative statements 'It is hotter than yesterday.', 'My bike is bigger'.
- make related statements eg 'Shaun is taller than Madison, Madison is shorter than Shaun'; 'I am older, you are younger'.
- (informal units) explain which choice of a cup, tablespoon, or teaspoon is preferable to move flour from the packet into a bowl.

Time

- refer to familiar recurring events when describing time, eg sunset, home-time
- respond appropriately to and use local, everyday descriptive and comparative language of time, eg before-now-after; day-night, wet-dry, high tide-low tide
- sequence 3 steps in familiar events, eg pictures of catching/cooking fish, daily classroom activities
- use and respond to days of the week, eg 'On Sunday I play cricket', 'Today is Friday'.

Chance

- use and respond to everyday language of chance such as 'might', 'maybe', eg 'I might win a prize in the class competition.', 'Our new baby might be a boy or a girl.'
- explain that different results are possible when the same actions are repeated, eg 'I got a 6 when I rolled the dice this time but I mightn't get a six next time', in a game of Jan-ken-pon - Japanese version of scissors-stone-paper.

Data Sense [SOSE]

- classify and organise objects using familiar criteria, eg sort names in class into kinship groups **[ILC-PK]**
- draw a picture/make a block graph to record their findings and summarise information by counting [Sci-WS], eg show different size bears in a scoop
- describe information from their own data collection and display, eg use data to say how many students have apple juice for lunch today.

Year 3 National Numeracy Benchmarks are 'blue' within this band

Measurement and Data Sense

Links

EsseNTial Learnings: Cr 1, Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas: Science; Perspectives: Literacy - Listening and Speaking

OUTCOMES

Learners demonstrating evidence of **Band 1**

MDS 1.1 Estimating and Measuring
estimate, **compare, describe and measure length**, area, **capacity**, volume **and mass using informal units;** estimate and measure length in cm and m

MDS 1.2 Using Relationships
describe relationships between relevant attributes and units when comparing and measuring things

MDS 1.3 Time
read key times on digital and analogue clocks, measure time intervals **and use calendars to locate information**

MDS 1.4 Chance
explain that some events are more likely or less likely to happen

MDS 1.5 Data Sense
collect, organise, **record** and use **data** to answer questions; **find and discuss information contained in simple graphs.**

INDICATORS

Learners demonstrating evidence of **Band 1** for example

Estimating and Measuring

- **use and respond to comparative** and superlative **language of length, capacity, mass and time, eg 'shorter than', 'heavier than', 'holds more than'** 'longest', 'shortest', 'heaviest', 'lightest'
- **distinguish which attribute (of length, capacity and mass) to use when comparing two objects, eg doesn't choose height alone to decide which glass holds more water**
- **(length) use direct comparison of length or height; use, but recognise limitations of, non-standard units such as paces when estimating, measuring and comparing, eg decide which of 2 people is taller by standing them back to back, explain why results are different when two people pace out the length of a running track**
- (length) use a metre ruler or tape measure correctly to find lengths in metres and/or centimetres **[HPE]**
- (area) order 3 objects according to area, eg compare and order areas of 3 envelopes and/or photos
- (capacity) estimate then **use direct comparison to determine which of two containers has the greatest capacity, eg pour water from 1 container to another & say which holds more**
- (mass) estimate then use direct comparison to determine which of two objects is heavier, eg use a bucket/ balance/see-saw and place an object at each end, state what the resulting movement means for the mass.

Using Relationships

- respond to statements involving relationships, eg 'Can the taller person jump further?' 'Does the tallest person have the longest arms?' 'Is the tallest window the widest?' **[HPE]**
- clarify the attributes being measured, eg 'By biggest do you mean tallest or widest?'
- (volume) explain that if one cup holds more sand than another then it also can hold more water **[Sci-WS]**

Time [SOSE-Soc]

- **read key times on analogue and tell the time in hours and minutes on a digital clock**
- **read and interpret straight-forward calendars, eg locate a date and state which day it is**
- **sequence and order events from own experience, eg create a picture sequence of events in a day, say that if it is April, a birthday in May will occur before a birthday in June,** sequence times for hunting different animals, and gathering bush foods, football season etc
- relate analogue and digital time, eg say that 6:45 means that the time is 45 minutes after 6 o'clock
- measure the passage of time in a variety of activities using devices such as candle clocks, sand timers, water clocks, tocker timers, metronomes

Chance

- **use and interpret everyday language of chance such as possible, impossible, maybe, likely, unlikely, and classify familiar events as either likely or unlikely, eg rain is possible on any day in the wet season but seems unlikely today because there are no clouds in the sky**
- decide which of two everyday events is more likely to happen, eg play at recess, go to library at recess
- decide which of two events is more likely to happen, eg predict and explain what is the most likely bear colour that is picked from a bag that has 3 green bears and 1 red one in it

Data Sense

[HPE] [Sci-WS] [SOSE] [LT-P] [LT-R]

- **collect**, organise, **present and interpret data to answer simple questions, eg keep a class record of the daily weather, the height of a plant**
- **present and interpret information in bar/column graphs and pictographs with simple one-to-one correspondence, eg 'This graph shows that most children walk to school', 'This graph shows how many different shellfish we collected today'**
- organise data into agreed categories and use a base-line to display data so comparisons can be made.

Measurement and Data Sense

Year 5 National Numeracy Benchmarks are 'blue' within this band

OUTCOMES

Learners demonstrating evidence of **Band 2**

MDS 2.1 Estimating and Measuring
use common metric units to estimate, measure and compare length, capacity and mass; count units to measure area and volume

MDS 2.2 Using Relationships
explain and use the relationship between length and perimeter, measurement tools and accuracy of measurements

MDS 2.3 Time
use analogue and digital clocks to tell time accurately; use basic timetables and a range of calendars to find information

MDS 2.4 Chance
predict and **explain the comparative likelihood of familiar chance events**

MDS 2.5 Data Sense
collect, organise, record, **display and interpret data in a variety of ways including graphs and simple tables** in order to answer questions.

Links

EsseNTial Learnings: Cr 1, Cr 2, Collaborative Learner, Con 1, Con 2,

Perspectives: Literacy - Listening and Speaking

INDICATORS

Learners demonstrating evidence of **Band 2** for example

Estimating and Measuring [Sci-WS]

- **(length) use estimation then measure** to the nearest graduation **in metres and centimetres to compare and order objects, eg measure heights of classmates so they can be placed in order**
- (length) measure in cm when marked but not labelled on ruler **[T&D-Pr]**
- **(area) use uniform, tessellating units to measure and compare areas, eg use a grid to work out the number of whole squares covered by two different footprints and say which is larger**
- (capacity) use appropriate **uniform informal units and litres** to describe, **estimate, measure, compare and order capacities, eg use a uniform unit such as a teaspoon to measure and compare the capacity of two containers; estimate & check which bucket hold more/less than a L**
- **(mass) use appropriate uniform informal units and kilograms to estimate, describe, measure, compare and order mass, eg ' the bottle is heavier than the glass because it weighs 12 blocks and the glass weighs 9 blocks'; 'this box weighs between 2kg and 3kg but is closer to 3kg'**
- investigate and report on how people of a range of cultures express distance between two places, eg Darwin to Lajamanu, measure in km or estimate how long it will take to get there .

Using Relationships [Sci-WS]

- state and use some formal **measurement units of length, capacity and mass and explain that the smaller the unit, the greater the number of units needed, eg 'the label of 500g relates to mass'; '1.5 litres is 11/2 litres'; '1.65m is more than 1 metre but less than 2m'**, say why less big tiles were needed to cover a table
- show the perimeter is the same when they make different closed shapes with a given number of matchsticks
- explain choice of tools, eg when a tape measure is used in preference to a metre ruler or trundle wheel
- explain the relationship between the number of repetitions of a task and the time taken to perform them, eg predict how many star jumps can be performed in one minute when 10 took 30 seconds **[HPE].**

Time [SOSE-Soc] [LT-P] [LT-R]

- **read clocks, calendars and timetables** and make simple schedules, **eg say that the time on an analogue clock is 8:47 or 13 minutes to 9, find out which bus leaves first after 9am, find what date is the 3rd Tuesday in the month**, make a schedule for a sports day **[SOSE-Soc]**
- **sequence**, compare **and order events from own experience, eg explain that 10am is earlier in the day than 2pm, 'A 95 minute video will go longer than 11/2 hours.'**, work out the time 3 hours ago
- estimate and measure time in minutes and/or seconds, eg use a stopwatch to measure the duration of tasks
- read Indigenous seasonal calendar from northeast Arnhem Land and identify correlation between non-Indigenous calendar months and Yolngu seasons .

Chance [Cr 2]

- **classify (familiar) events as having an equal or more or less chance of happening, eg 'A fair coin toss has equal chance of being heads or tails.' 'We are more likely to see a bike in the park than a truck.'**
- identify and record all possible outcomes from a simple experiment, eg 2 dice being tossed
- predict which colour will come up most often on a random generator, eg on a spinner, test the prediction

Data Sense [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- **collect, present and interpret data to answer simple questions, eg order heights of classmates; make a table showing colours of cars in the school car park; state that there are always more cars in the car park on Mondays; present information in a list, table, column, bar or pictographs where one picture represents more than one piece of data**
- **read and interpret column and bar graphs where the numbers between intervals are not necessarily marked, eg a column graph in the paper where the axis is labelled 5, 10...**
- use and interpret graphical methods that involve simple scale to display discrete and continuous data
- extract specific information from data summarised in diagrams and tables, eg Venn diagram.

Year 7 National Numeracy Benchmarks are 'blue' within this band

Measurement and Data Sense

Links

EsseNTial Learnings: Cr 1, Cr 2, Collaborative Learner, Con 1, Con 2,

Learning Areas: HPE, Science, SOSE, Technology and Design;

Perspectives: Literacy, LT

OUTCOMES

Learners demonstrating evidence of **Band 3**

MDS 3.1 Estimating and Measuring
choose appropriate units and use common measuring instruments to estimate, measure and compare length, capacity, mass and temperature

MDS 3.2 Using Relationships
explain and use the relationship between units of measurement and between length, area and volume when solving simple problems

MDS 3.3 Time
tell time accurately including 24 hour time, **read timetables, timelines and calendars and use relationships between common time units**

MDS 3.4 Chance
predict the chance of an event occurring; **explain chance based on simple experimental data**

MDS 3.5 Data Sense
collect and organise information in a variety of ways to answer questions posed by themselves/others and critically interpret data presented in a variety of ways.

INDICATORS

Learners demonstrating evidence of **Band 3** for example

Estimating and Measuring [Sci-WS]

- make reasonable estimates using **appropriate standard units, eg 'That tall person is about 180cm tall.' 'It holds a bit less than a drink can - it's about 300mL.' 'It's hot today so it's probably over 30°C.'**
- **read and measure length, capacity and mass in appropriate standard units, eg read distance between two towns on a map as 50km not 50mm, record a person's weight shown on a digital scale as 43.2kg**
- **read a scale accurately to the nearest marked graduation**, including where graduations are not labelled, eg **read 5.4cm on a ruler,** use a protractor to find the size of an angle
- **(length, mass and capacity) use appropriate familiar referents to describe, compare and order objects, eg pace out length of a fence, knowing that a large pace is about 1m; say 'This must weigh about 500g because it feels the same as a tub of margarine.'; use a 2L ice-cream container to measure the capacity of a fish tank**
- **(area and volume) describe, measure and compare and order areas and volumes, eg recognise that changing the shape of a ball of play dough or rearranging a set of cubes doesn't change the volume of an object, count squares/part squares to find the area of irregular shapes**
- use a ruler and/or protractor to draw a variety of shapes and objects on grid/isometric paper **[Num-SS].**

Using Relationships

- make a variety of closed shapes with the same perimeter and compare their areas
- find and use different ways of measuring perimeter and area of 2D shapes, eg cutting a triangle and arranging it into a rectangle to help determine its area
- investigate and explain the effect on volume of doubling linear dimensions of a regular prism.

Time [SOSE-Soc]

- **use timetables, calendars and relationships between common time units to solve problems including creating timetables, eg 'training is every Monday for 6 weeks from January 19 so the last one will be on February 23'**, read a TV program and convert to 24 hr time to program a VCR
- distinguish starting and finishing time from elapsed time, eg **work out that if a watch shows 5:40, in 30 minutes it will be 10 past 6**
- construct a seasonal calendar for local area incorporating Western calendar and Indigenous seasons, including times of year local bush food is ripe .

Chance [Cr 2]

- **use quantitative data to make judgements about chance, eg state yellow to be most likely out of a collection with 18 yellow, 10 red and 5 blue marbles**
- **conduct investigations to produce data about chance events, eg toss 2 fair coins 200 times**, predict and **record the results and comment that '2 heads' came up about one quarter of the time [LT-R].**

Data Sense [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- **determine what data to collect, present data in an organised form including tables/graphs**
- **comment on key features of data, eg ask whether the lunch break should be shorter, record daily temperature on a line graph, note that all children in a class are between 130cm and 170cm**
- **read and interpret data presented in a variety of ways** including scaled axes, **eg say 'the column graph shows nearly twice as many white cars'; 'the pie chart shows about 25% of children don't like caps'; 'The table** (Carroll diagram) **shows that of 17 berries, 10 were red & edible, 5 were red and not edible.'**
- use highest, lowest, middle scores and means when summarising data, eg put heights in order to find the highest/lowest/middle; find the mean height when there is enough data to make averaging sensible.

Chance and Data

OUTCOMES

Learners demonstrating evidence of **Band 4**

CD 4.1 Posing questions and collecting data
design and implement surveys and experiments to generate appropriate data to answer specific questions or address an identified issue, accounting for types of variables

CD 4.2 Experiments involving chance
devise and execute simple simulations to determine the related theoretical probabilities (sample space, randomness, probability)

CD 4.3 Presenting and Summarising Data
construct tables and graphs appropriate to the identified variables and analyse these to identify patterns and trends; use measures of central tendency and spread when describing data

CD 4.4 Interpreting Data
interpret and evaluate information presented in a range of tables and graphs, including comments on centre, spread and appropriateness of data collection methods.

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2,

Learning Areas: HPE, Science, SOSE, Technology and Design

INDICATORS

Learners demonstrating evidence of **Band 4** for example

Posing questions and collecting data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- explain and apply the entire statistical investigation process, (ie posing questions, collecting data, presenting and summarising data, interpreting data) in relevant contexts, eg opinions on lowering/ raising the driving age
- collaborate to develop and trial survey questions to collect categorical or ordinal data, assessing the suitability of the questions and methods used, eg open-ended, yes/no, multiple choice questions
- explain and apply strategies to collect data reliably, including from prepared databases, eg clearly defining categories or criteria, recording consistently
- distinguish between discrete and continuous data, eg counting as opposed to measuring.

Experiments involving chance [Sci-WS]

- design, implement and interpret simple experiments/devices to test or explain theoretical probabilities; explain that all probabilities can be expressed as values between 0 and 1
- list all possible outcomes for a simple experiment and use the results, giving reasons, to predict the outcomes of repetition of the experiment eg rolling two dice, simultaneously tossing two coins
- design and explain a device to fit specified probabilities, eg make a spinner so that the probability of it stopping on red is 0.5, blue is 0.2 and green is 0.3
- investigate and report on the sample space of an experiment, using strategies such as tree diagrams, graphs, lists and tables; state the probability of outcomes as fractions or decimals
- use fractions and decimals to assign probabilities, eg 14 students in a class of 30 are boys, explain the probability of selecting a boy at random is 14/30.

Presenting and Summarising Data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- independently organise data in a frequency table
- organise ungrouped data in tables and display in a column graph, eg throw of two dice
- organise data in tables with provided class intervals and display in a histogram, eg time intervals for athletics results
- use fractions or percentages to compare data, eg family origins (kinship/state or origin)
- select and use the best measure of central tendency within a given context, eg select and justify the most appropriate way of expressing sports score 'averages'
- use stem plots to group and display discrete data, eg number of babies born per week in a hospital.

Interpreting Data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- extract and interpret information from a variety of graphs and tables (including stem plots and box plots), commenting on the shape, centre and spread of the distribution, with reference to the context
- analyse and evaluate the appropriateness of graphical representations and measures of central tendency used in published data eg use of mode to describe average height
- evaluate statements and assertions about a situation represented in a data display, eg misleading displays due to inappropriate sample, graphical representation
- write a report on an investigation, based on primary data, describing initial questions, data collection processes, statistical analysis and commenting on how they might be improved.

Chance and Data

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas: HPE, Science, SOSE, Technology and Design

OUTCOMES

Learners demonstrating evidence of **Band 5**

CD 5.1 Posing questions and collecting data
plan data collection, working individually and collaboratively, taking care in formulating questions and deciding how data should be organised before it is collected from a variety of appropriate sources

CD 5.2 Experiments involving chance
use systematic strategies to calculate or estimate probabilities and use primary or secondary data to assign probabilities for one and two-stage events

CD 5.3 Presenting and Summarising Data
organise data in diagrams and tables, with individually or collaboratively planned class intervals and display data to show frequency and spreads

CD 5.4 Interpreting Data
interpret and critique own and published data, making adjustments and inferences where appropriate.

INDICATORS

Learners demonstrating evidence of **Band 5** for example

Posing questions and collecting data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- design simple questionnaires and undertake trials to assess the quality of the questions
- collect information, including bi-variate data, from a variety of sources including databases and give reasons for their choice
- make distinctions between: random/non-random data; sample and the population from which it was drawn
- plan ways to ensure that data is collected consistently
- organise raw data to examine it for inconsistencies and errors, eg group data on pulse rate, identify two outliers and conclude there may have been an error in recording data
- plan and carry out simple simulations, using graphics calculators and computers where appropriate.

Experiments involving chance [Cr 2] [Sci-WS]

- use published data to assign probabilities to events, including compound events, eg use meteorological data to state the probability of a day in Darwin in January being wet and having a maximum of over 30°C
- use census data to assign probabilities, eg use data about their school population to decide the probability that a member of a school group will be female **[SOSE]**
- represent sample space using set notation, tree diagrams, Venn diagrams or lattice diagrams
- investigate independent events, eg the probability of getting a sum of 7 from 2 dice
- interpret 'and', 'or' and 'not' when used to describe events, eg explain that the probability of winning first AND second prize is less than of winning first prize
- assign and use odds and subjective probability, eg 3 to 1 against.

Presenting and Summarising Data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- construct grouped frequency tables including cumulative frequency and mid-point scores to calculate the mean, median and modal class
- organise data to examine it for errors and inconsistencies and reorganise data to answer other questions within a research project
- use methods, (eg back-to-back stem plots, bar graphs, double column graphs) to compare two sets of univariate data
- calculate inter-quartile range and construct box and whisker plots from raw data using the median, quartiles and range
- use fractions and percentages to describe the variability (or spread or dispersion) of results, eg all of the estimates were between 21 and 35 but 80% were between 27 and 31 seconds
- use electronic means to provide summary statistics, including measures of spread, and appropriate visual displays, eg scatterplots or time series plots.

Interpreting Data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- explain orally or in writing what is indicated by summary statistics, tables and graphs taken from sources such as magazines, newspapers, information leaflets and school textbooks
- make predictions based on samples
- informally interpret relationships and reach conclusions from scatter plots.

Chance and Data

OUTCOMES

Learners demonstrating evidence of **Beyond Band 5**

CD 5+.1 Posing questions and collecting data
plan experiments, simulations and surveys, collaboratively and independently, considering the appropriateness and quality of observations, the suitability of samples or populations

CD 5+.2 Experiments involving chance
estimate and calculate probabilities, proportions, means and medians based on primary and secondary data collection and assign probabilities using complementarity and independence

CD 5+.3 Presenting and Summarising Data
compare, choose and use methods of organisation to suit the type of data and the questions asked; display and summarise data to compare data sets and to show relationships within a data set

CD 5+.4 Interpreting Data
interpret collected and published data from tables, diagrams, plots, graphs, prose and databases to make comparisons, describe relationships and construct arguments.

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas: HPE, Science, SOSE, Technology and Design

INDICATORS

Learners demonstrating evidence of **Beyond Band 5** for example

Posing questions and collecting data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- identify faults in proposed or conducted questionnaires, eg leading, ambiguous, misleading or memory-reliant questions, and investigate the effect on responses of two forms of a questionnaire prepared from alternative viewpoints, eg on gun law reform **[Con 4]**
- decide when a sample is adequate and when a census is needed
- select and use types of samples, eg convenience, random, self-selection, stratified random, and relate sample size to purpose.

Experiments involving chance [Cr 2] [Sci-WS]

- identify and explain possible causes of chance variation such as measurement error, sampling error, changes over time
- distinguish dependent and independent events and relate to everyday interpretations of phenomena
- estimate probabilities and proportions from simulation data, eg estimate the probability that a class would be over-full if a particular number of places were offered
- investigate and report accurately on the probabilities involved in games, eg chance, raffles
- calculate and interpret conditional probabilities.

Presenting and Summarising Data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- design nested and layered tables to represent data involving more than two variables, eg plan how to represent information about age, gender and music preferences in one table
- use electronic means to: provide summary statistics, including standard deviation; investigate the effect of outliers on summary statistics; produce a scatterplot and line of best fit for bivariate data
- use interquartile box plots to compare the location and variability of several sets of univariate data, eg the scoring patterns of netball players in a team for overall scores, consistency
- describe the effect of outliers on summary statistics, eg use a scientific calculator to investigate measures of location, variability and association for data sets which vary systematically
- use either mean or median smoothing to smooth a plot of data over time, eg when studying temperature variations
- demonstrate how data can be manipulated to different ends, eg role-play opposing positions on a public issue such as immigration using the same set of data to develop arguments, AusAid to Asian countries.

Interpreting Data [HPE] [Sci-WS] [SOSE] [LT-P] [LT-R] [LT-S]

- describe scatter plots as suggesting positive, negative or no association (correlation) and place informal expressions of correlation on a scale of - 1 to 1, eg 'strong negative correlation'
- comment on assumptions made in data collection and the potential sources of errors, eg samples, question bias, measurement errors, recorder bias
- critically evaluate arguments of others, commenting on connections between data and the conclusions reached, and discuss the use and misuse of a variety of visual representations in published materials.

Number Sense

Links

Essential Learnings: Refer to specific links listed below.

Learning Areas: Refer to specific links listed below.

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 1**

NS KGP1 attend to, anticipate, respond to, initiate interaction with and explore sensory stimuli using their senses (auditory, visual, tactile, and/or kinaesthetic).

INDICATORS

Learners demonstrating evidence of **Key Growth Point 1** for example

Numbers, Number Systems and Patterns

- recognise individual parts as 'belonging' to a whole, eg the body **[HPE-PD]**
- express choice for one object over another **[In 1]**
- make the connection between a symbol and a real object, eg pictographs (compic), photos, icons or shapes on concept keyboard **[LT-R]**
- distinguish money from other objects
- recognise the use of money in play situations
- show understanding of the link between pressing buttons and a display/response **[Con 1]**
- give an object 'on cue', eg 'Give me one bead.'
- express a need/want for more (or less).

Number Sense

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 2**

NS KGP2.1 Numbers and Number Systems
recognise, name and use single digit numbers in simple, familiar contexts

NS KGP2.2 Patterns and Relationships
begin to rote count and use some one-to-one correspondence; recognise and use simple patterns.

NS KGP2.3 Calculating - no outcome at this level

INDICATORS

Learners demonstrating evidence of **Key Growth Point 2** for example

Numbers and Number Systems

- distinguish numerals from other symbols and shapes **[LT-R]**
- begin to distinguish one numeral from another, eg can tell the difference between 1 and 3 show that they recognise that there is an order in the counting of numbers by beginning to say them in order **[LT-R]**
- recognise where numbers are used in everyday life, eg on a phone, television, clock, bus, house
- use appropriate language or gestures for 'nil' or 'nothing' **[Lit-LS]**
- respond to terms such as 'first' and 'last' **[Lit-LS]**
- state or indicate their age
- match items to people, eg one apple per child
- use calculators to represent chosen numbers **[LT-R]**
- demonstrate understanding of numbers used in books, eg recognises numerals in simple picture books about counting **[Lit-RV]**
- use or respond to language associated with number, eg all, many, few, a lot, a little **[Lit-LS]**
- identify numerals of buttons on a calculator and link these to the digital numerals displayed **[LT-R]**
- sort/match/count small collections of coins **[Col 1]**
- show money is used to operate a vending machine, eg requests money to get a drink from a machine.

Patterns and Relationships

- begin to recognise that when we count, we say a number for each object ie, 1-1 correspondence (not necessarily accurately)
- match a small collection one-to-one using materials or pictures
- recognise collections of 1, 2 and 3 to simplify counting tasks, eg, subitising or seeing' groups of 2 or 3 without counting
- repeat rhymes and songs and cooperate in games involving numbers and number patterns or counting, eg sing 'Ten Green Bottles', make groups of three, make a two colour repeating pattern with blocks **[Arts-SkP]**
- respond to and count small collections in play situations, eg 'How many books do you have?' Say 'We need three bears.' or 'Can I have two blocks?'.

Links

EsseNTial Learnings: Cr 1, Collaborative Learner, Con 1, Con 2

Learning Areas: All Learning Areas depending on context.

Perspectives: Literacy, Learning Technology

Number Sense

Links

EsseNTial Learnings:
Cr 1, Collaborative Learner, Con 1, Con 2

Learning Areas:
All Learning Areas depending on context.

Perspectives:
Literacy, Learning Technology

OUTCOMES

Learners demonstrating evidence of **Key Growth Point 3**

NS KGP3.1 Numbers and Number Systems
recognise, order and use 1 and 2 digit numbers in familiar contexts

NS KGP3.2 Patterns and Relationships
count, matching counting to objects and describe simple number patterns in familiar contexts

NS KGP3.3 Calculating
add and subtract small numbers when they occur in play/stories and draw pictures, use materials or calculators to record and solve these; state the value of some coins and use them in play situations.

INDICATORS

Learners demonstrating evidence of **Key Growth Point 3** for example

Numbers and Number Systems

- say or indicate number names up to 2 digits and respect order when counting, eg Asian Island hopping game 
- match oral names to familiar written numbers and write recognisable versions of them including multiples of tens and teen numbers
- use tens and ones to model 'familiar' 2 digit numbers, eg. use MAB to show the number of learners in a class or any 2-digit number shown on a calculator
- make or draw a collection of a given size, eg respond correctly to 'Give me 7 pencils please' **[LT-P]**
- identify digital numerals, eg on a calculator, video recorder, microwave oven display **[LT-R]**
- respond to and use '1st, '2nd and '3rd to indicate position, eg 'I was second on the computer'.

Patterns and Relationships

- copy and continue in materials the pattern of counting numbers or 'skip counting' by 2s 3s, 5s or 10s, eg make a staircase pattern or 1, 2, 3, 4. cubes **[LT-R]**
- invent their own repeating pattern with a range of materials, eg use keyboard to make a four note tune then play it over and over; use coloured beads to make a 3 colour repeating necklace **[Num-SS] [LT-R]**
- make the calculator count by a given number (1s, 2s or 3s) using the in-built constant function, eg in a group, one child uses the calculator to count by twos for the total number of 'eyes'. The group then checks by counting.
- use materials such as tiles, counters and egg cartons/ grid paper to show odd, even, doubling and halving
- use odd/even number patterns to locate house numbers.

Calculating

- say or indicate how many are in visible collections of objects, eg shown 8 drinks, can respond to the question 'how many are there?' **[LT]**
- use the last number said as the answer to 'How many?' when counting small collections, and are not distracted by the arrangement of the objects
- visualise small numbers as groupings of other numbers, eg see 7 as and 
- create number questions about familiar stories, eg 'How many children are in the family?' or 'Who is the eldest?' **[Cr 3]**
- use materials to make equal groups, eg make 3 groups of 2; share 12 into 3 equal groups
- decompose numbers and represent them in a variety of ways to help when adding or subtracting, eg think of 5 and 3 more in the same way as two 4s
- mentally work out hidden numbers with sums to at least 10, eg watch as 6 oranges are counted into a box, then as 4 are removed (one at a time), say there are 2 left
- use their own mental counting strategies to mentally add and subtract small numbers generated from stories, eg Patrick found 3 eggs and then he found 2 more, how many does he have now? What if he found 3 more?
- use coins in play situations to imitate buying goods and are aware of differences in money value of goods, eg chips versus TV set **[LS]**
- use calculators to add and subtract numbers up to two digits, including verifying the result of an estimate and interpreting the display.

Number Sense

Year 3 National Numeracy Benchmarks are 'blue' within this band

OUTCOMES

Learners demonstrating evidence of **Band 1**

NS 1.1 Numbers and Number Systems
apply place value knowledge to **compare, order** and use **2** and 3-**digit numbers** and demonstrate awareness that these numbers belong to a larger system; use familiar common fractions in real situations

NS 1.2 Patterns and Relationships
identify and use patterns and relationships **in 2 digit numbers**, based on repeated addition and subtraction

NS 1.3 Calculating
recall or work out basic addition and subtraction facts; decide which operation to use and whether to estimate, calculate mentally or use a calculator to add or subtract whole numbers in familiar contexts and solve multiplication and division problems concretely; recall the value of coins and commonly used notes **and use them in practical situations.**

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2,

Learning Areas: All Learning Areas depending on context.

Perspectives: Literacy, Learning Technology

INDICATORS

Learners demonstrating evidence of **Band 1** for example

Numbers and Number Systems

- **use place-value knowledge to read, record and model two** and three **digit numbers, eg** enters 208 on a calculator, explaining that there are two 'hundreds', no 'tens' and eight 'ones'; write 176 as part of a paragraph about the learners at school; **given 86, can show that as 8 tens and 6 ones, 7 tens and 16 ones, etc.**
- use language of large numbers (sometimes inaccurately) to express magnitude of large quantities, eg 'millions of stars', 'thousands of people at the shop' **[Lit-LS]**
- **recognise and show one half of collections and half of a whole, eg show 1/2 of 10 pencils; fold/cut a string in 1/2 to give 1/2 to a friend**
- use materials to show one quarter of a collection or whole object, eg cut a sandwich into quarters when asked
- estimate the size of a collection (up to 20) by visually grouping (subitising) or comparing the group with one of known size **[LT-R].**

Patterns and Relationships

- **identify patterns in numbers to 99, including by counting in multiples, eg count forwards by 5s from 20; continue the pattern 3, 6, 9, 12... or** 4, 7, 10, 13 ... ; **recognise odd and even numbers up to 20**
- order sets of related addition or subtractions to generate additional facts based on patterns, eg use 1 + 14, 2 + 13 etc. to generate other sums to 15 **[LT-R]**
- use addition and subtraction relationships to write related equations, eg 3 + 5 = 8 so 3 = 8 - 5; **[LT-R]**
- use place value to solve related equations, eg 6 + 7 = 13, 16 + 7 is 10 more so 16 + 7 = 23
- use relationships between addition and subtraction to solve missing number sentences, eg 4 + _ = 9.

Calculating

- **recall, or work out mentally, basic addition facts to 10+10 and related subtraction facts using strategies, such as**
  - ***count*** **on and count back (eg calculate 11 take 2 by saying 11, 10, 9)**
  - ***make*** **up to 10 (eg calculate 8 +5 by adding 2 to get 10 then adding 3 to get 13)**
  - ***commutativity*** **(eg when calculating 3 + 8, start with 8 and add 3)**
  - ***doubles and near doubles*** **(eg use double 8 to calculate 8 +9 or 8+7)**
  - ***related facts*** **(eg calculate 14 take 8 by recalling 8 + 6 = 14)**
- **add and subtract whole numbers in familiar contexts, choosing the most appropriate method and checking that results make sense eg**
  - **use mental methods for '34 learners in the class, 20 go to the library, how many are left?'**
  - **count on from 28 to solve 30 less 28; add 20 to 47 by adding 2 tens to make 67**
  - **use written methods up to/including 2 digits with no regrouping** and simple regrouping , eg
    24+37 = (20+4) + (30+7); 50+11= 61)
  - **use calculators with numbers up to 3 digits** including regrouping **and interpret the display [LT-R]**
- **use materials or diagrams to represent and solve simple multiplication and division problems, eg draw 2 rows of 5 chairs; put 20 children into 4 equal groups**
- **recognise coins and know their value, eg make up $3.20 using various coins, work out the value of a set of coins - up to $5, compare the value of coins with the price of an item [LS]**
- recognise common notes and know their value, eg make up $25 using various notes.
- **use number sense and a range of strategies including materials and calculators to solve word and picture problems, eg 37 seats on a bus, 24 people on board, how many more can fit?, 'If 29 girls and 32 boys are in our Primary School, how many learners are there altogether?' [LT-R].**

Year 5 National Numeracy Benchmarks are 'blue' within this band

Number Sense

Links

EsseNTial Learnings: Cr 1, Collaborative Learner, Con 1, Con 2

Learning Areas: All Learning Areas depending on context;

Perspectives: Learning Technology

OUTCOMES

Learners demonstrating evidence of **Band 2**

NS 2.1 Numbers and Number Systems
apply place value knowledge to **compare, order and use whole numbers** up to 5 digits **and decimal fractions to two places in familiar situations (including money and measurements)** and explain that these numbers belong to a larger system; **use, describe and record common fractions in a variety of ways**

NS 2.2 Patterns and Relationships
use number patterns and relationships involving addition, subtraction, multiplication and division to describe, generate and continue sequences and simple statements of equality

NS 2.3 Calculating
recall addition and subtraction facts and **recall, or work out mentally, multiplication facts; decide on the best way to calculate and accurately use any of the methods, including appropriate use of estimation.**

INDICATORS

Learners demonstrating evidence of **Band 2** for example

Numbers and Number Systems

- **use place value knowledge to read, record, compare, interpret and model whole numbers, eg enter** fifty-**three thousand and forty eight on a calculator, compare the lengths of the world's 4 longest rivers**, order capital cities by population; **say that 740 has the same value as 74 tens**
- **read, record and compare money and measures with the same number of decimal places - up to 2 digits, eg state that 2.6 on the calculator might mean $2.60, explain that a 1.25L bottle holds more than a 1L bottle and less than a 2L bottle, say that 2.4m is higher than 1.8m**
- **enter and read amounts of money/measurements on a calculator, rounding displays to nearest cent/unit, eg 1.5 = $1.50 [LT-R]**
- **find a unit fraction of an object or a collection and** use materials and diagrams to represent fraction amounts **(limited to halves, thirds, quarters**, fifths, eighths **and tenths) eg break off one-third of a stick of chalk, say there is only 1/4 of a cake left, divide a group in half to play a team game.**

Patterns and Relationships

- u**se multiples to count by 2s**, 3s, **5s and 10s,** eg take 3 at a time, saying 3, 6, 9, 12 and 2 more is 14
- **continue or fill spaces in number sequences based on addition or subtraction (0.2, 0.4, 0.6 ....)**
- complete numerical statements involving brackets where one number is 'missing' (19 +6) x __ = 50
- use the relationship between multiplication/ division to solve missing number problems, eg rewrite _ x 7 = 56 as 56/7
- use a simple given rule, expressed in everyday language, to generate a sequence of numbers, eg start with 3 and add 2 each time
- predict and check the value of a given term in a sequence, eg the 20th term in the sequence 1, 3, 5, 7...

Calculating

- recall basic addition facts and **recall, or work out mentally, multiplication facts to 10 x 10 including using strategies such as: doubles; skip counting (eg, 6, 12, 18, 24...); related facts, eg when solving 6 x 8 recall 5 x 8 = 40 and add 8; commutativity, eg 9 x 2 = 2 x 9**
- **make mental extensions of known facts, eg 6 x 3 = 18 so 6 x 30 = 180**
- select appropriate multiplication to deal with repeated addition
- **estimate when adding and subtracting whole numbers/ amounts of money and choose mental, written or calculator methods as appropriate when solving problems in familiar contexts, eg**
  - **mentally calculate $1.10 + $1.30; uses 8 + 9 = 17 to solve 80 + 90**
  - **mentally work out that items costing $4.25 and $3.60 together will cost between $7 and $8**
  - **use written methods with whole numbers up to 3 digits and money amounts with regrouping**
  - **use a calculator with numbers to 4 digits and interpret the display [LT-R]**
- **mentally estimate the results of a calculation to check reasonableness of results, eg says 493 is not reasonable when doing 117 + 76 on a calculator**
- **solve multiplication and division problems in familiar contexts**, eg mentally solve 63 divided by 3, use a calculator to work out the cost of one can of drink if a carton of 12 cans is $9.00; 'If there are 4 teams of 11 children, how many children are there?'
- **use written methods to multiply** 3 **(2) x1 digits and divide** 3 **(2) x 1 digits (without remainders)**
- round numbers to the nearest 10, 100, 1000 to make estimation easier
- suggest a story that relates to a given number sentence .

Number Sense

Year 7 National Numeracy Benchmarks are 'blue' within this band

OUTCOMES

Learners demonstrating evidence of **Band 3**

NS 3.1 Numbers and Number Systems
explain the recurring patterns in the Base 10 number system and **use** any **whole numbers, and decimals to** 3 **(2) decimal places (eg money/measurements); use, describe and record equivalences between common fractions, decimals, key percentages and simple ratios**

NS 3.2 Patterns and Relationships
use order of operations and number relationships to solve equations; **identify** and explain **the rule used to generate a number pattern**

NS 3.3 Calculating
accurately add, subtract, multiply and divide using a variety of strategies including fluent use of mental estimation and calculators.

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas: All Learning Areas depending on context.

Perspectives: Learning Technology

INDICATORS

Learners demonstrating evidence of **Band 3** for example

Numbers and Number Systems

- **compare, order, record and use large whole numbers and decimal fractions to 3 (2) decimal places, eg say which of two cities has the larger population; recognise that 1.7m is longer than 1.65m; correctly record a distance when told it is 38 450km; enter 17 dollars and 95 cents accurately on a calculator - write the result of 130 divided by 25 correctly as 5.2 not 52**
- **recognise the place value of digits within numbers including those with up to 3 (2) decimal places and recognise that whole numbers may be written as decimals, eg**
  - **1.5 million is also 1 500 000; 0.45 on a calculator might represent 45 cents,**
  - **154cm can be written as 1.54m, the 5 in $12.45 is worth 5 cents or 5 hundredths of a dollar**
- **read, name, record and compare simple common fractions and recognise equivalences, eg**
  - **say that 3/8 of a pizza is less than a 1/2 because 1/2 = 4/8; state that 20% = 1 1/5 = 0.2;**
  - **nterpret diagrams and models of fractions of collections and label with the appropriate fraction limited to halves, thirds, quarters, fifths, eighths and tenths**
- use symbols (=, <, >) to state comparisons between numbers.

Patterns and Relationships

- **create, continue and describe number patterns including constant multiplication or division**, and generate the rule for a given pattern, **eg continue patterns such as 17, 24, 31 and 38; place value-based 2843, 2943, 3043; say that 9, 15, 21, 27 is an 'add 6' pattern; say 2, 6, 18, 54 is a 'times 3' pattern**
- explain and justify their conjectures about items in a sequence by referring to the previous element, eg 'The pattern could be one more each time because the first jump was 3, then 4, then 5, then 6.'
- continue a growth pattern based on shape and identify/ describe the resulting number pattern
- accurately construct and verify complex arithmetic statements of equality, using order of operations, eg (4x3) + 10 - 2 = (7x2) +6.

Calculating [LT-R]

- fluently and flexibly use all addition, multiplication and related subtraction and division facts
- **use the inverse relationship between addition/ subtraction and multiplication/division to solve problems in familiar contexts**
- **estimate answers in familiar contexts and state where the estimate is reasonable and sufficient**
- **choose mental, written or calculator methods when solving addition, subtraction, multiplication and division problems in familiar contexts including whole numbers, decimals, unit fractions, eg**
  - **mental: calculate $2 - 65cents; 2 digit addition and subtraction; estimate sums and products by rounding to multiples of 10, (eg 456 +572 is about 500 +600 = 1100); divide 120 by 4**
  - **written: multiply and divide 3 digit by 1 digit numbers; add numbers with equal decimal places**
  - **electronic: find how many drinks at $1.85 can be bought with $35 (and interpret the remainder display);** use memory function to make an efficient calculation of total costs
- **use number sense to solve one/two-step problems, eg 'I am 12 years old this year, what year will I turn 50?'; 'Stadium Australia seats 110 000 people, if it is half full, how many seats are empty?'; count by 6s to calculate an AFL score**
- **represent, interpret and solve problems involving many representations of division,** eg deal with remainders appropriately when $13 is shared between 4 people they get $3.25 each but sharing 13 balloons results in 3 each, remainder 1 while sharing 13 pizzas results in 31/4 pizzas each
- **solve problems involving simple ratios with whole numbers and money, eg 'If it costs $5 for 2 drinks, how much would 10 drinks cost?'**
- restate a problem symbolically, eg 4 lengths of rope each 4.75 metres long is 4 x 4.75.

Number

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas: All Learning Areas depending on context.

Perspectives: Learning Technology

OUTCOMES

Learners demonstrating evidence of **Band 4**

N 4.1 Numbers and Number Systems
represent, compare, order and manipulate numbers including fractions, decimals, percentages, directed, ratios, surds, pi and indices

N 4.2 Patterns and Relationships
(no outcome at this level - refer to Algebra Strand)

N 4.3 Calculating
select, extend and apply facts, patterns and strategies including mental, written and electronic methods, for calculations involving rational numbers.

INDICATORS

Learners demonstrating evidence of **Band 4** for example

Numbers and Number Systems

- explain and apply the continuous nature of the rational number system by identifying numbers between 2 decimals eg identify two heights between 1.74m and 1.75m
- use positive and negative numbers to model, compare and order measurements in relevant contexts, eg altitude, temperatures **[SOSE] [Sci]**
- use common equivalences between decimal and common fractions and percentages when comparing quantities, eg 'One third off isn't as good as 40%.' **[SOSE-Ent]**
- apply ratio concepts to a variety of situations, eg converting recipes for different sized groups
- classify, and use appropriate terminology to describe elements of the rational number system, eg whole numbers, integers, rational/ irrational numbers
- develop and apply the first six index laws through directed investigation.

Calculating

- recognise and apply the relationship between prime factors, highest common factor and lowest common multiple to express and manipulate numbers in fractional and integer forms
- accurately apply order of operations, eg describe the conditions under which an arithmetic statement will be true or not true, eg insert brackets to make a statement true: 2 + 3 x 6 - 2 = 14
- develop, explain and use efficient **mental** computation strategies, eg
  - decompose multiple digit numbers to multiply by single digit numbers, eg 46 x 7 as 40 x 7 & 6 x 7,
  - use 'front-end' estimation and round to the nearest whole, eg 3 and a third plus 2 and a half is more than 5; 16.67 +4.12 +0.97 is about 17 + 4 + 1 is about 22
  - convert numbers to assist in efficient computation, eg fractions to decimals, mixed numbers to improper fractions
- develop and apply strategies for efficient **written** computation of rational numbers, eg
  - divide decimals by one-digit numbers, interpreting remainders
  - add columns of decimal fractions, including those with unequal number of decimal places
- use an **electronic** calculation tool to accurately and efficiently complete complex calculations, **[LT-R]** eg
  - express one quantity as a percentage of another
  - establish appropriate order of operations
  - representation of fractions and percentages
  - interpret the meaning of 'overflow' displays
- check reasonableness of result by another method, eg mental estimation, calculator, pen and paper approximations
- apply number sense and appropriate computation strategies in a range of business mathematics contexts, **[SOSE-Ent]** eg
  - deal routinely with situations involving personal finance, eg savings, tax, wages, discount
  - design a room make-over given a budget of $12, 000
  - develop a personal budget in order to save for a medium-term goal such as a first car.

Number

OUTCOMES

Learners demonstrating evidence of **Band 5**

N 5.1 Numbers and Number Systems
represent, compare, order and manipulate numbers including direct proportion, surds, fractional and directed indices, and scientific notation

N 5.3 Calculating
select, extend and apply facts, patterns and strategies including mental, written and electronic methods, for calculations involving rational and irrational numbers.

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2,

Learning Areas: All Learning Areas depending on context.

Perspectives: Learning Technology

INDICATORS

Learners demonstrating evidence of **Band 5** for example

Numbers and Number Systems

- use scientific notation to represent and compare very large and very small numbers in manageable form including interpreting e-notation as used by calculators
- interpret published ratios, rates and percentages to make comparisons, eg
  - use mortality or illness rates to discuss health issues
  - use interest rate information to compare loan options.
- develop generalisations of whole powers, square roots, ratios and scientific notation; and whole, fractional and negative number patterns electronically **[LT-R]**
- develop and apply the seventh and eighth index laws
- apply index laws to develop and manipulate scientific notation, eg in chemistry for very small numbers and in astronomy for very large numbers **[Sci]**
- use rational approximations and surd forms for square roots and distinguish irrational square roots as non-recursive, non-terminating decimals, eg link to quadratic roots.

Calculating

- use, refine and justify efficient **mental** estimation and computation strategies, eg
  - use automatic recall of decimal and percentage equivalents of common fractions to calculate the percentage of a quantity, eg mentally calculate a 50%, 25%, or 10% discount on particular items
  - decide whether to round up or down to the nearest, based on the purpose of the estimation, eg 'To buy three pairs of socks at $3.79, I will need $12 rather than $9.'
  - use strategies such as rounding or decomposition to estimate percentages and decimal fractions, eg 9% is a bit less than 10%, find 15% by finding 10% and adding half again
  - use a method such as the unitary method to solve problems involving proportional quantities, eg find the price of 4.5kg of fruit given the price of 2kg by first calculating the price of 1kg
  - increase or decrease a quantity in a given ratio or by a given percentage, eg convert a recipe for 4 people into one for 10
- use understood **written** methods to add, subtract, multiply and divide decimal fractions, rounding to specified numbers of places, eg find 13.6 x 11.3 to one decimal place
- use **electronic** computation methods strategically and expediently, eg
  - apply order of operation correctly, using brackets for division eg $\frac{2-3}{4-26}$ is $(2-3) \div (4-26)$
  - use an efficient method for evaluating powers and roots, eg use the xy key (root x and x to power 1/y), root 10 = _____ and (root 10 squared) = 10
  - explain that truncating or rounding calculator displays can affect results of calculator computations.
- apply rates and proportional concepts in a range of real life contexts, eg
  - identify and explain direct proportion in familiar situations, such as a fixed rate of pay where income will be directly proportional to hours worked
  - use price and concentration to compare cordial; compare stocking rates of stations as well as the number of cattle on each
  - investigate and calculate simple and compound yearly interest.

Number

Links

EsseNTial Learnings:
Cr 2, Collaborative Learner, Con 1, Con 2

Learning Areas:
All Learning Areas depending on context.

Perspectives:
Learning Technology

OUTCOMES

Learners demonstrating evidence of **Beyond Band 5**

N 5+.1 Numbers and Number Systems
represent compare, order and manipulate numbers including inverse proportion, surds, indices and logarithms

N 5+.3 Calculating
appropriately select and apply mental, written or electronic strategies for calculations involving surds, indices and logarithms.

INDICATORS

Learners demonstrating evidence of **Beyond Band 5** for example

Numbers and Number Systems [LT-R]

- rationalise the denominator of surd expressions in order to solve problems involving surds
- explain that all common fractions can be expressed as a recurring or terminating decimal and vice-versa
- choose and use the appropriate representations of surds and indices in order to solve problems involving logarithms
- solve rate, ratio, direct or indirect proportion problems electronically
- explain that inverse proportion is a special case of one variable increasing as the other decreases

Calculating

- use electronic computation methods to enhance efficiency in complex and repetitive calculations including evaluation a result at several stages, **[LT-R]** eg
  - use a spreadsheet to calculate the balance of a loan for 20 successive months
  - use in-built functions in a calculator to compute basic statistical and trigonometric ratios
- explain the effect of different methods of approximation on the closeness of the estimate for different operations, eg rounding for pi early in a series of calculations instead of applying the pi approximation at the end of the calculations
- model statements of equality between ratios involving quantities directly or inversely proportional
- convert from one rate to another in order to compare and order them
  - compare consumption of 3 litres per second and 3 kilolitres per hour
  - compare petrol consumption of 7.6 litres per 100km with 9km per litre
- identify and use appropriate logarithmic laws in order to solve exponential equations, eg growth and decay
- use base 10 logarithms to solve equations such as $2^{x+1} = 3$.

Algebra

OUTCOMES

Learners demonstrating evidence of **Band 4**

A 4.1 Global Features of Functions
sketch and interpret graphs of functions using global features, including intercept and slope

A 4.2 Linear Functions
derive, represent and interpret linear functions in electronic, tabular, symbolic and graphical form

A 4.5 Coordinate Geometry
plot and interpret coordinates on the Cartesian plane; calculate the slope between two given points

A 4.6 Equations and Inequalities
manipulate, construct and solve linear and other simple equations and inequations in a variety of contexts, defining the domain.

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2

Perspectives: Learning Technology

INDICATORS

Learners demonstrating evidence of **Band 4** for example

Global Features of Functions [LT-R]

- use the coordinate system and substitution to locate any point on the graph of a function
- use a graphics calculator to investigate and explain the effect of adding a constant to any function **[Lit-LS]**
- describe the slope at any point on the graph, eg slope indicates speed within travel graphs
- move between and express linear functions in a variety of representations including symbolic, table of values, graph, graphics calculator screen, spreadsheets.

Linear Functions

- recognise and derive a linear relationship from a given context, eg patterns within matchstick problems
- explain that the constant term in a function gives the y intercept of the function, and apply in graphing
- given a table of values, plot the graph, identify a pattern and write the linear equation
- given a graph, generate a table of values, identify a pattern and write the rule
- choose a range of strategies to determine the slope, including difference tables
- use graphics calculators to investigate and report on the impact of scale on **[LT-R]**
  - the appearance of slope, eg varying the scale of only one axis for the function y = x
  - displaying a graph, eg y = 49x + 2000
- given a graph and a context, use linear features to recreate the story.

Coordinate Geometry [Lit-LS] [Lit-W] [LT-R]

- investigate and report on the slope of horizontal and vertical lines and write the corresponding equations
- given that slope/gradient is defined as rise overrun, use technology and other means to investigate and report on the relationship between the slope of a linear graph, its equation and table of values
- derive a rule for finding the slope of a graph of any linear function
- apply linear function facts such as gradient and intercepts to a range of contexts, eg car rental, STD/mobile phone rates.

Equations and Inequality

- expand and collect like terms to simplify equations
- apply expansion, collection of like terms and factorisation to show equivalence
- algebraically represent and solve a variety of word problems
- solve simultaneous equations graphically, within a range of contexts, eg identifying the better of two mobile phone schemes **[LT-R]**
- solve equations and word problems involving simple fractions, eg represent simple inequations on the number line

$$\frac{x-3}{2} = 4$$

- select an appropriate formula, determine the unknown variable, and rearrange the formula to solve the problem.

Algebra

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2,

Perspectives: Literacy, Learning Technology

OUTCOMES

Learners demonstrating evidence of **Band 5**

A 5.1 Global Features of Functions
sketch and interpret graphs of functions using global features, including intercepts, maxima and minima, transformation and shape; move fluently between representations

A 5.2 Linear Functions
use linear functions to model real data using slope, intercepts and systems of equations

A 5.3 Quadratic Functions
identify, represent and interpret key features of quadratic functions in electronic, tabular, symbolic and graphical form

A 5.5 Coordinate Geometry
calculate and interpret perpendicular and parallel gradients, and calculate midpoint and distance

A 5.6 Equations and Inequalities
model, construct and solve linear and quadratic equations and inequations, and manipulate complex formulae, in a variety of contexts.

INDICATORS

Learners demonstrating evidence of **Band 5** for example

Global Features of Functions [LT-R]

- use local maxima and minima, intercepts and axes of symmetry to assist in graphing functions
- use tables, graphs and programming features generated with a graphics calculator to efficiently and accurately sketch the graph of a function
- generalise particular types of functions, eg draw five graphs that pass through the point (0,6), find their equations and generalise an equation for all such graphs [y = mx + 6]
- describe the slope at any point on the graph as positive increasing, positive decreasing, negative increasing, negative decreasing or constant **[Lit-LS] [Lit-W]**
- move fluently between and express functions in a variety of representations including symbolic, table of values, graph, graphics calculator screen, spreadsheets.

Linear Functions [Lit-LS] [Lit-W] [LT-R]

- apply linear functions to solve a variety of problems
- use spreadsheets to explore and report on 'What if' scenarios involving linear relationships
- given a graph including multiple linear equations and a context, use linear features to recreate the story

Quadratic Functions [Lit-LS] [Lit-W] [LT-R]

- recognise and derive a quadratic relationship from a given context, eg optimising area given perimeter
- explain that the constant term in a function gives the y intercept of the function and apply in graphing
- given a graph, identify the key features and write the quadratic rule
- use graphics calculators to investigate and report on the impact of scale on
  - the shape, eg varying the scale of only one axis for the function $y = x^2$
  - displaying a graph, eg $y = 49x^2 + 2000$
- use quadratic functions to model phenomena, where appropriate, and determine the relevant domain, eg trajectories, lenses
- devise a rule for moving the vertex of a quadratic from $y = x^2$ to any point on the plane
- investigate and report on the relationship between the differences of two squares and the roots of a quadratic
- develop and apply the quadratic formula to determine the roots and factors of a quadratic
- recognise and apply special factorisation techniques, eg perfect squares and difference of perfect squares

Coordinate Geometry [Lit-LS] [Lit-W]

- develop a formula for the distance between two points and the midpoint of a segment, through directed, collaborative investigation
- efficiently apply midpoint and distance formulae to a number of contexts
- investigate and report on the relationship between parallel and perpendicular gradients

Equations and Inequality

- translate linear and quadratic equations and inequalities embodied in stories and word problems into algorithmic form and vice-versa
- solve equations in one variable which have been developed from a combination of invertible operations by backtracking, eg root

$$\frac{2}{x+3} = \frac{1}{4}$$

Algebra

OUTCOMES

Learners demonstrating evidence of **Beyond Band 5**

A 5+.3 Quadratic Functions
use quadratic functions to model real data using symmetry, critical points and intercepts

A 5+.4 Exponential Functions
identify, represent and interpret key features of exponential and logarithmic functions in electronic, tabular, symbolic, and graphical form

A 5+.6 Equations and Inequalities
model, construct, manipulate and solve exponential equations in a variety of contexts.

Links

EsseNTial Learnings: Cr 2, Collaborative Learner, Con 1, Con 2

INDICATORS

Learners demonstrating evidence of **Beyond Band 5** for example

Quadratic Functions

- work flexibly and fluently with algebraic expressions within their experiences to rearrange them into more useful forms for a purpose, eg express $x^2 - 2x + 7$ as $(x - 1)^2 + 6$ to facilitate curve sketching
- solve a variety of maxima/ minima problems using graphical and numerical techniques, eg flight of a stone
- manipulate different forms of notation including factorised forms in different domains, eg graphical calculator, spreadsheet.

Exponential Functions

- identify the main features of a function from its algebraic expression, eg know that $f(x) = 50 \times 2^x$ will have positive values, be increasing at an increasing rate, have small values for negative x and rapidly increasing values for positive x
- demonstrate control over axes/scales/intervals in different domains, eg graphical calculator, spreadsheet, pencil/ paper
- generate linear, parabolic, exponential and trigonometric graphs in different domains, eg graphical calculator, spreadsheet, pencil/paper.

Equations and Inequalities

- formulate inequalities, (eg linear, simple powers and exponential) to represent constraints, eg three punters lose $100 overall and each loses more than $25; the total cost of production must be no more than $1000 but labour is typically double the cost of materials
- use substitution to decide the status of particular pairs of values with respect to a symbolically expressed inequality, eg does (7,3) satisfy $a + b < 10$?
- solve linear inequalities in one variable algebraically, eg backtrack to solve $5n + 3 < 33$
- use graphs to solve one or two inequalities, eg shade the plane to show $y = 2x$, $y < 2^x$ and $y > 2^x$ respectively
- solve linear and quadratic equations iteratively using a spreadsheet
- show the equivalence (identity) of algebraic expressions eg for all non-zero real values of x and y:

$$\frac{1}{x} + \frac{1}{y} = \frac{(x + y)}{xy}$$