

Mathematics

Upper primary

Syllabus 2003

Section 2

Learning outcomes

and indicators



Papua New Guinea
Department of Education

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Secretary's Message

The current reforms in education have been in progress since 1992. The Education Reform has emphasised community-based schooling, the use of vernacular languages in schools, the introduction of Elementary Schools and the expansion of Primary schooling to grade 8 and increased access to Grades 9 and 10.

This syllabus is to be used by Upper Primary (Grades 6, 7 and 8) students in Primary schools throughout Papua New Guinea. This syllabus develops, extends, links and builds upon concepts, skills and attitudes flowing from Lower Primary (Grades 3, 4 and 5). This syllabus provides a sound foundation for further learning in the reformed school system.

Students' language abilities, already gained in their home environments and during the previous years of schooling, must be respected, built on and extended. Vernacular languages have a large part to play in our students' formative years and their first language should be used to promote a deeper understanding of difficult concepts when this is appropriate.

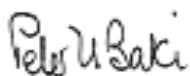
The Upper Primary Mathematics Syllabus contributes significantly towards achieving Integral Human Development. Without a sound working knowledge of mathematics, a person's ability to function effectively is severely restricted. This course is designed to promote both a firm understanding of practical everyday mathematics and the theoretical basis to support higher learning.

By studying Mathematics, students will take an active role in building their societies and appreciating others by using the acquired numeracy skills.

Building on the Lower Primary course, students focus on developing numerical, analytical and investigative skills to solve real life problems likely to be encountered in their societies as well as in the outside world. This knowledge and skills will enable students to perform mathematical tasks in everyday life and to be useful members of society as well as preparing for further mathematical studies.

This course is designed to allow and indeed to encourage active integration primarily between the different units of mathematics and also between mathematics and all other subjects. Such integration will result in providing the practice and skills that will set the ground for lifelong learning.

I commend and approve this syllabus as the official curriculum for Mathematics to be used in all Upper Primary schools throughout Papua New Guinea.



Peter M. Baki
Secretary for Education

Learning Outcomes

Numbering of Learning Outcomes

Each Learning Outcome is numbered with three digits, such as 6.2.3.

The first number refers to the Grade level. The second number refers to the Strand. The third number refers to the Outcome in the Strand.

Thus, 6.2.3 refers to an Outcome at Grade 6, Strand 2 and Outcome number 3.

Strand	Grade 6	Grade 7	Grade 8
Number and Application	6.1.1 Add, subtract, multiply and divide fractions	7.1.1 Solve problems requiring any of the four operations including mixed numbers	8.1.1 Apply fractions in problem solving
	6.1.2 Add, subtract, multiply and divide decimals	7.1.2 Use decimals to solve problems set in familiar contexts	8.1.2 Use decimals to solve real life problems
	6.1.3 Convert between simple fractions and decimals	7.1.3 Convert between fractions, decimals and percentages	8.1.3 Convert freely between fractions, decimals, percentages and ratios
	6.1.4 Link fractions and decimals to percentages and solve simple percentage problems	7.1.4 Use percentages in a variety of real life situations	8.1.4 Solve problems in any situation that involves percentages
	6.1.5 Recognise ratios	7.1.5 Convert between ratio and fractions	8.1.5 Apply ratios in solving problems from real life
	6.1.7 Recognise and explain the use of directed numbers	7.1.6 Recognise and relate rates to graphs	8.1.6 Apply rates to solve simple problems from real life
	6.1.7 Recognise and explain the use of directed numbers	7.1.7 Use directed numbers in concrete problems	8.1.7 Apply directed numbers in problem solving
	6.1.8 Use indices to the power of 2 and 3	7.1.8 Use positive indices greater than the power of 1	8.1.8 Use integer indices and fractional indices where the answers are rational

Strand	Grade 6	Grade 7	Grade 8
Space and Shape	<p>6.2.1 Estimate, measure and compare using metric units</p> <p>6.2.2 Convert between metric units of length and round off</p> <p>6.2.3 Calculate the perimeter of shapes</p> <p>6.2.4 Find the area of composite shapes</p> <p>6.2.5 Investigate and use area rules for triangles and rectangles</p> <p>6.2.6 Investigate volumes of simple solids to determine rules</p> <p>6.2.7 Investigate capacity</p> <p>6.2.8 Convert between metric units</p>	<p>7.2.1 Estimate and measure using metric units and lengths from maps and other sources</p> <p>7.2.2 Use appropriate metric units in calculations</p> <p>7.2.3 Investigate and measure the circumference of circles</p> <p>7.2.4 Compare areas by estimation</p> <p>7.2.5 Investigate area rules for quadrilaterals</p> <p>7.2.6 Investigate volumes of compound prismatic solids and use rules to determine volumes</p> <p>7.2.7 Investigate the relationships between capacity and volume</p> <p>7.2.8 Use appropriate units for capacity and solve capacity problems</p>	<p>8.2.5 Investigate the area of circles</p> <p>8.2.6 Investigate volumes of cylinders, cones and pyramids and apply some volume rules</p> <p>8.2.7 Apply capacity and volume measurements in problem solving</p> <p>8.2.8 Convert between a variety of units: capacity and volume, and metric and imperial</p>

Strand	Grade 6	Grade 7	Grade 8
Space and Shape	<p>6.2.9 Draw and investigate properties of polygons</p> <p>6.2.10 Make tessellations using regular shapes</p> <p>6.2.11 Identify different angles</p> <p>6.2.13 Construct nets of regular solids</p> <p>6.2.14 Identify and use compass directions</p> <p>6.2.15 Use and make keys and scales on maps</p> <p>6.2.16 Use map grids and coordinates to locate points</p>	<p>7.2.9 Draw, investigate and make physical models of quadrilaterals</p> <p>7.2.10 Create irregular shapes that tessellate</p> <p>7.2.11 Determine the interior and exterior angles of triangles and quadrilaterals</p> <p>7.2.12 Construct and determine properties of angles</p> <p>7.2.13 Design nets for various solids</p> <p>7.2.14 Give the direction of a location relative to others as a bearing</p> <p>7.2.15 Make maps having scales and keys, from suitable data</p> <p>7.2.16 Use a four-quadrant number plane</p>	<p>8.2.9 Make physical models of circles and investigate their properties</p> <p>8.2.10 Investigate rotational tessellations</p> <p>8.2.11 Investigate properties of interior and exterior angles of polygons</p> <p>8.2.12 Use appropriate words to identify and describe angles and shapes accurately</p> <p>8.2.13 Associate nets with the solids they form</p> <p>8.2.14 Use and read maps accurately</p> <p>8.2.16 Use longitude and latitude to locate places on a map</p>

Strand	Grade 6	Grade 7	Grade 8
Measurement	<p>6.3.1 Use appropriate units for weights in measurements and calculations</p> <p>6.3.3 Investigate temperature and the thermometer as a measuring instrument</p> <p>6.3.4 Use a variety of time records</p>	<p>7.3.1 Use charts and graphs to read and record weights and solve problems related to weight</p> <p>7.3.2 Recognise weight as a force</p> <p>7.3.3 Read a thermometer scale and compare measurements</p> <p>7.3.4 Manipulate time to solve problems</p>	<p>8.3.1 Solve real life weight problems</p> <p>8.3.2 Differentiate between weight and mass</p> <p>8.3.3 Display temperatures including those from specialist thermometers</p> <p>8.3.4 Recognise relationships between location and time</p> <p>8.3.5 Use time-rate calculations</p>
Chance and Data	<p>6.4.1 Collect and interpret locally relevant statistical data</p> <p>6.4.2 Explore empty sets, intersections and unions</p> <p>6.4.3 Explore the results of independent events</p> <p>6.4.4 Discuss sources of error meaningfully</p>	<p>7.4.1 Compare sets of data</p> <p>7.4.2 Use a variety of classification methods</p> <p>7.4.3 Calculate probabilities from individual event probabilities</p> <p>7.4.4 Apply strategies to reduce error</p>	<p>8.4.1 Interpret information presented statistically</p> <p>8.4.2 Use sets to solve problems from real life</p> <p>8.4.3 Explore the social implications of probability</p> <p>8.4.4 Combine error-reducing strategies to get the best result</p>

Strand	Grade 6	Grade 7	Grade 8
Chance and Data	6.4.5 Discuss the value of accuracy	7.4.5 Choose appropriate levels of accuracy	8.4.5 Represent levels of accuracy
	6.4.6 Estimate quantities and numbers	7.4.6 Use a variety of estimation strategies	8.4.6 Identify and select appropriate estimation strategies
	6.4.7 Round off amounts	7.4.7 Estimate sums of money	8.4.7 Estimate results of calculations
Patterns and Algebra	6.5.1 Identify different methods used for packing	7.5.1 Use different packing patterns to pack objects	8.5.1 Apply packing patterns in solving problems in real life
	6.5.2 Explore number patterns	7.5.2 Relate number patterns and algebraic statements	8.5.2 Recognise and use patterns in processes
	6.5.3 Use pronumerals	7.5.3 Substitute numbers for pronumerals	8.5.3 Manipulate simple algebraic expressions and solve real life problems

Learning Outcomes and Indicators

STRAND : NUMBER AND APPLICATION

Sub-strand	Grade 6	Grade 7	Grade 8
Fractions	6.1.1 Add, subtract multiply and divide fractions	7.1.1 Solve problems requiring any of the four operations involving mixed numbers	8.1.1 Apply fractions in problem solving
Indicators All Indicators are listed as bullet points after each Outcome. The list of Indicators always begins with the following statement: 'Students will be achieving this outcome when they, for example'.	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • add and subtract fractions, including those with different denominators, and mixed numbers • freely convert between mixed numbers and improper fractions • use the reciprocal of a fraction to solve a division problem by multiplication • multiply and divide fractions, including those with different denominators, and mixed numbers • correctly place fractions and mixed numbers on a number line to show comparative size • solve simple problems that require the addition, subtraction, multiplication or division of fractions 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve problems by methods of divided rectangles • solve problems by first converting to improper fractions • solve problems that require addition and or subtraction of mixed numbers with any simple denominators • solve simple problems, which require more than one operation • solve division problems 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve problems such as $12 \frac{1}{4} \times \frac{1}{2}$ • solve problems like $12 \frac{1}{2} \times 0.25$ by using fractions • solve problems such as 'In a class of 45, there are 27 boys. One third of the boys and half of the girls play soccer. How many soccer players are there in the class?'

Sub-strand	Grade 6	Grade 7	Grade 8
Decimals	<p>6.1.2 Add, subtract multiply and divide decimals</p>	<p>7.1.2 Use decimals in solving problems set in familiar contexts</p>	<p>8.1.2 Use decimals to solve real life problems</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve problems such as $0.320 + 1.162$, $2.711 - 1.304$ • solve problems such as 3.162×4, $2.255 \div 3$ • solve problems such as one metre of material costs K5.25, how much do 5 metres cost? 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve problems such as $0.115 - 2.015$, $12.101 - 6.0009$ • solve problems such as 2.1115×5, 3.002×2.11 and 12.20121 divided by 32 • solve problems such as the sum of 1.455 km plus 450.5 m + 0.100 km • use decimals to three places in solving problems set in a familiar context • solve money-based problems using any of the four operations • round decimals to any given number of places 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve problems from real life situations • present data in decimal format accurately

Sub-strand	Grade 6	Grade 7	Grade 8
Fractions and Decimals	<p>6.1.3 Convert between simple fractions and decimals</p>	<p>7.1.3 Convert between fractions, decimals and percentages</p>	<p>8.1.3 Convert freely between fractions, decimals, percentages and ratios</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • change $\frac{1}{2}$ to 0.5, $\frac{1}{4}$ to 0.25, $\frac{3}{4}$ to 0.75, $\frac{3}{10}$ to 0.3, and $\frac{4}{10}$ to 0.4 • change for example 0.5 to $\frac{1}{2}$, $0.32 = \frac{32}{100} = \frac{8}{25}$ 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • change $\frac{3}{8}$ to 0.375 to $37\frac{1}{2}\%$ or 37.5% (avoid fractions which lead to repeating decimals) • change 2.015 to $\frac{2015}{1000} = \frac{403}{200}$ to 201.5% or $201\frac{1}{2}\%$ 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • change 60% to $\frac{60}{100} = \frac{6}{10} =$ to 0.60 • change 75% to 3:4 to $\frac{3}{4}$ to 0.75 • change 50% to $\frac{1}{2}$ to 0.5 to 1:1 • use percentage, decimal notation fraction or ratio interchangeably to suit the application • solve problems such as $K15.00 + 10\%$, as $K15 + (.01 \times K15) = K15 + K1.50 = K16.50$

Grade 7	Grade 8		
Decimals and Percentages	<p>6.1.4 Link fractions and decimals to percentages and solve simple percentage problems</p>	<p>7.1.4 Use percentage in a variety of real life situations</p>	<p>8.1.4 Solve problems in any situation that involves percentages</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • show percentage as a shaded fraction of a 100 squares • convert 10, 15, 20, 25, 50 75, 80 and 100% to decimals and fractions • convert $\frac{1}{10}$, $\frac{1}{5}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 whole to decimals and % • mark percentages, decimals, fractions and mixed numbers correctly on a number line to show their relative size. • solve calculations such as 5% of 50, 10% of 73, 3% of 24, 120% of K5.00. • answer questions such as ‘What is the price of a K25.00 meri blouse if the store is offering 20% off?’ • evaluate simple interest problems such as K1 000.00 @ 10% per year for 2 years 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • determine the price of articles with 10% discount • determine the price of articles plus 10% VAT • solve problems such as ‘A car is sold for K16,500 including 10% VAT. What is the price without VAT?’ 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve problems involving percentages that would be encountered in a trading situation

Sub-strand	Grade 6	Grade 7	Grade 8
<p>Ratios and Rates</p> <p>Indicators</p>	<p>6.1.5 Recognise ratios</p> <p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • identify problems such as 'add 1 part powdered milk to 4 parts water' as ratio problems. • identify scales on maps as ratios • name situations in which ratios are used, such as gears on a car or bicycle, levers, mixtures and state the relevant ratio from each example 	<p>7.1.5 Convert between ratios and fractions</p> <p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • change 3:7 to $\frac{3}{10}:\frac{7}{10}$ where $10 = 3+7$ • simplify 8:12 by dividing common factor, such as $8:12 = 2:3$ or changing ratios to fractions $8:12 = \frac{8}{12} = \frac{2}{3}$ and $\frac{8}{20} = \frac{2}{5}$ and $\frac{2}{5} = 2:5$ 	<p>8.1.5 Apply ratios in solving problems from real life</p> <p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve VAT problems where VAT is applied in the ratio 1:10 • solve mixing problems, such as 'Concrete may be mixed in the ratio 2:5.5, cement, sand and gravel? How many buckets of cement should be mixed with 30 buckets of gravel?'

Sub-strand	Grade 6	Grade 7	Grade 8
Ratios and Rates Indicators		<p data-bbox="767 472 1043 539">7.1.6 Recognise and relate rates to graphs</p> <p data-bbox="767 618 1066 719">Students will be achieving this when they, for example</p> <ul data-bbox="767 786 1082 1066" style="list-style-type: none">• determine the rate of a graph as its slope or rise over run• recognise a rate as a fraction of two different items, such as 3 metres for every 5 seconds, is a rate of $\frac{3}{5}$ m/s or 0.6 m/s	<p data-bbox="1107 472 1414 573">8.1.6 Apply rates to solve simple problems from real life</p> <p data-bbox="1107 618 1406 719">Students will be achieving this when they, for example</p> <ul data-bbox="1107 786 1414 1245" style="list-style-type: none">• solve problems such as 'How much for five metres at a rate of K6 per metre?' 'How long will it take to travel 20 km at a rate of 5 km/hour?'• solve problems such as 'Water is dripping from a tap at a rate of 42 drops every 6 minutes, how long will it take to drip 400 drops?'

Sub-strand	Grade 6	Grade 7	Grade 8
Directed Numbers	<p>6.1.7 Recognise and explain the use of directed numbers</p>	<p>7.1.7 Use directed numbers in concrete problems</p>	<p>8.1.7 Apply directed numbers in problem solving</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • name a variety of measurements that can be negative, such as temperature, elevation or balance of an account • explain the meaning of a negative measurement in each situation above 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • determine solutions to problems by use of number lines, counters or other aids, positive or negative 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve problems such as $3-5$, -2×10 • solve problems such as finding an account balance at the end of a trading period during which the account falls below zero

Sub-strand	Grade 6	Grade 7	Grade 8
Indices	<p>6.1.8 Use indices to the power of 2 and 3</p>	<p>7.1.8 Use positive indices greater than the power of 1</p>	<p>8.1.8 Use integer indices and fractional indices where the answers are rational</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • calculate solutions to numbers such as 3^2, 4^3 • express products like 4×4 as 4^2, 9×9 as 9^2, $3 \times 3 \times 3$ as 3^3 • recognise 1, 4, 9, 16, 25, 49, 64, 81, 100 as square numbers • recognise 1, 8, 27 and 64 as cubic numbers 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • calculate numbers such as 2^5, 3^4 • express products like $3 \times 3 \times 3 \times 3 \times 3$ as 3^5 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use whole number indices positive, negative and zero • can show the patterns formed by use of indices • recognise that $3^1 = 3$, $4^0 = 1$ and $6^{-3} = \frac{1}{6^3}$ • recognise square numbers between 1 and 200 and hence know their square roots • recognise cubic numbers to 100 and hence know their cubic roots • find solutions to problems such as 'What number multiplied by itself is equal to 36?' • recognise that 2 is the same as the square root of 4

Strand: SPACE AND SHAPES

Sub-strand	Grade 6	Grade 7	Grade 8
Length	<p>6.2.1 Estimate, measure and compare using metric units</p>	<p>7.2.1 Estimate and measure using metric units and lengths from maps and other sources</p>	
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • offer reasonable estimates for heights of objects in a picture based on heights of familiar objects • offer reasonable estimates for lengths of objects they can directly observe: $\pm 10\%$ • measure a variety of objects to the nearest mm, cm, or m depending on the initial size • measure longer distances in kilometres or metres as appropriate • choose an appropriate unit for any given measurement 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • estimate lengths in metres and kilometres to within $\pm 10\%$ • measure the distance around the school boundary in metres and compare it with their prior estimate • measure the distance from home or town in kilometres using a map and its scale • use appropriate metric units to measure long distances • measure accurately using appropriate tools and units 	

Sub-strand	Grade 6	Grade 7	Grade 8
Length	<p>6.2.2 Convert between metric units of length and round off</p>	<p>7.2.2 Use appropriate metric units in calculations</p>	
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • convert metres to millimetres or vice versa • convert metres to kilometres or vice versa • sum group measurements of mixed units to get an answer in a single unit • determine a length of a building given sufficient measurements of parts in different units including also some fractional measurements • round off amounts to the nearest place as appropriate 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • convert a mixture of measurements to a single measurement and round off to the lowest accuracy before addition and subtraction • convert to the same measurement and multiply or divide then round to the same accuracy as the measurements • convert mixed units to those that result in the easiest calculations • freely convert units in a problem to make the solution simpler 	

Sub-strand	Grade 6	Grade 7	Grade 8
Length	<p>6.2.3 Calculate the perimeter of shapes</p>	<p>7.2.3 Investigate and measure the circumference of circles</p>	
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • measure the three sides of a triangle and determine its perimeter • measure just two sides of a rectangle to determine its perimeter using rules they have determined themselves • measure the distance around circles and other irregular objects by suitable strategies 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use rolling and wrapping of string or paper around cylinders to measure circumference • divide circumference by diameter to determine a fixed ratio • obtain reasonable estimate of the value of C/D, that is π to $\pm 10\%$ from measured values 	

Sub-strand	Grade 6	Grade 7	Grade 8
Area	6.2.4 Find the area of composite shapes	7.2.4 Compare areas by estimation	
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none">• divide compound areas into square metres or square centimetres as appropriate and count these to determine the total area• find the area of a classroom floor not including the spaces occupied by cupboards or the teacher's desks• find the area of the classroom end wall including the triangle at the top• find the area of the classroom sidewall excluding the windows and the door	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none">• distinguish areas differing by as little as 10% through visual inspection and estimation only• regularly make estimates of areas accurate to $\pm 10\%$ before calculation and compare these to the calculated value to verify the calculation	

Sub-strand	Grade 6	Grade 7	Grade 8
Area	<p>6.2.5 Investigate and use area rules for triangles and rectangles</p>	<p>7.2.5 Investigate area rules for quadrilaterals</p>	<p>8.2.5 Investigate the area of circles</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve the area of a rectangle by multiplying the number of squares along adjacent sides • solve for the area of a triangle by halving the product of its height and base • find the area of compound shapes by applying the rules to component parts and adding or subtracting as required 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve the area of trapeziums, kites, parallelograms and rhombuses by suitable rules • solve areas of irregular quadrilaterals by treating them as compound shapes 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • compare the area of circles to the area of inscribed squares and the square of the diameter • determine the area of circles by counting squares • relate the measured area of circles to the square of the diameter • circumference: $C = \pi D$

Sub-strand	Grade 6	Grade 7	Grade 8
Volume	<p>6.2.6 Investigate volumes of simple solids to determine rules</p>	<p>7.2.6 Investigate volumes of compound prismatic solids and use rules to determine volumes</p>	<p>8.2.6 Investigate volumes of cylinders, cones and pyramids and apply some volume rules</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • determine volumes of simple solids: cubes and cuboids, by counting unit cubes • determine volumes of simple solids: prisms, by counting unit layers and multiplying by the area of each layer • determine volumes of simple solids: prisms, from suitable length measurements 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • determine volumes of compound prismatic solids as the sum of volume of its parts • regularly find volumes of simple solids by applying rules for volume 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • determine the capacity of hollow cylinders, pyramids and cones and convert that to volumes and use the results relate to the length measurements of the shapes • build approximations to the shapes from centicubes to determine approximate volumes and again relate these to the length measures • recognise that the volume of a cylinder can be found by multiplying the area of the end by its height or length • recognise that both the volume of a cone and a pyramid depend on the area of the base and height in the same way as each other • solve problems involving calculation of volumes by choosing appropriate rules and using them

Sub-strand	Grade 6	Grade 7	Grade 8
Capacity	<p>6.2.7 Investigate capacity</p>	<p>7.2.7 Investigate the relationship between capacity and volume</p>	<p>8.2.7 Apply capacity and volume measurements in problem solving</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • Compare the capacity of different shaped containers by measuring the capacity in mL or L as appropriate, using measuring cups or cylinders 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • Submerge objects of known volume to measure their displacement • Determine the volume of a given quantity of liquid by placing it in a container of regular shape so that the volume can be calculated 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • Convert freely between capacity and volume measures during the problem-solving process as convenient

Sub-strand	Grade 6	Grade 7	Grade 8
Capacity	<p>6.2.8 Convert between metric units</p>	<p>7.2.8 Use appropriate units for capacity and solve capacity problems</p>	<p>8.2.8 Convert between a variety of units: capacity and volume, and metric and imperial</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • change freely between the different units of capacity, such as 345 mL = 0.345 L • change between different units of area: square centimetres, square metres, hectares • change between the different units of volume: cubic centimetres and cubic metres 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • determine the capacity of a container given its measurements in length units • choose capacity measurements appropriate to the size of the vessel, such as for a cuboidal vessel 5 m x 0.2 m x 0.01 m, V = 0.010 m cubed, which is most sensibly expressed as 10 L as a capacity 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • convert between gallons and litres, feet and metres, inches and millimetres using 1 gallon = 4.5 L, 1 foot = 0.3 m and 1 inch = 25 mm as sufficiently accurate conversions • convert between capacity measures and volume measures

Sub-strand	Grade 6	Grade 7	Grade 8
Shapes	<p>6.2.9 Draw and investigate properties of polygons</p>	<p>7.2.9 Draw, investigate and make physical models of quadrilaterals</p>	<p>8.2.9 Make physical models of circles and investigate their properties</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • describe models of rectangles and triangles, such as ‘A rectangle has two equal longer opposite sides and two equal shorter opposite sides, one pair at right angles to the other pair’ • draw regular polygons such as triangles, rectangles, squares up to dodecagons • identify some properties of polygons, such as the number of edges, vertices, angles, axis of symmetry, number of pairs of parallel sides 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • make models of quadrilaterals: parallelogram, rhombus, kite and trapezium using paper, card, sticks, wire • make models of quadrilaterals and name them, such as ‘parallelogram’ • draw quadrilaterals such as parallelogram, rhombus, kite and trapezium • identify the properties of quadrilaterals drawn by students, such as number of parallel sides, number and position of equal length sides, equal angles, complementary angles, axis of symmetry 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • draw circles on card and cut them out • mark diameter, radius, centre, circumference arc, segment on circles they have drawn and cut out • show relationship between parts of a circle, such as circumference and diameter, diameter and radius, sector and arc • investigate value of pi: π, by measuring the circumference and the diameter of cylindrical items

Sub-strand	Grade 6	Grade 7	Grade 8
Tessellations	6.2.10 Make tessellations using regular shapes	7.2.10 Create irregular shapes that tessellate	8.2.10 Investigate rotational tessellations
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • make tessellations using regular shapes cut from paper or card • draw tessellations using regular shapes • distinguish between tessellating and non-tessellating regular shapes 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use a rectangular piece of paper and make an irregular cut through the middle and then glue the two outer edges together to make an irregular tessellating shape • repeat the process by cutting the shape in the perpendicular direction and rejoining to make a tessellating shape with all edges irregular • create interesting shapes that tessellate 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • Create tessellations that have rotational symmetry • Identify traditional and modern patterns in handcrafts with rotational symmetry

Sub-strand	Grade 6	Grade 7	Grade 8
Angles and Shape	6.2.11 Identify different angles	7.2.11 Determine the interior and exterior angles of triangles and quadrilaterals	8.2.11 Investigate properties of interior and exterior angles of polygons
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use two paper arms fastened together at a point to make acute, right, obtuse, straight and reflex angles • identify the different types of angle formed by the hands on a clock face, such as three o'clock is a right angle • label different angles according to type • are able to add and subtract angles • use words such as right angle, obtuse angle, reflex angle to describe angles in shapes • use words such as supplementary, complementary, adjacent, interior, exterior to describe angles in different positions and relationship to each other 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • determine the total interior and exterior angles of triangles by measuring the separate angles and adding them together • determine the total interior angles of quadrilaterals by cutting off the corners and placing them together to find the total angle • determine the total interior angles of triangles by cutting off the corners and placing them together to find the total angles 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • find the interior angle sum for simple polygons • make a rule for the interior angle sum of polygons based on numbers of internal triangles • explain the relationship of exterior and interior angles

Sub-strand	Grade 6	Grade 7	Grade 8
<p>Angles</p> <p>Indicators</p>		<p>7.2.12 Construct and determine properties of angles</p> <p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • construct angles: full turn, straight, right, 60°, 45°, 30°, using compasses and rulers • estimate the size of angles and then measure them with protractors • bisect angles (straight, right, 60°, 30°) using compasses and rulers and show the relationship between the different parts and the whole • use properties of congruent, adjacent, complementary and supplementary angles to identify unknown angles • identify congruent, adjacent, supplementary and complementary angles 	<p>8.2.12 Use appropriate terms to describe angles and shapes accurately</p> <p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use words such as <i>complementary</i>, <i>supplementary</i>, <i>corresponding</i>, <i>co-interior</i>, <i>exterior</i>, <i>alternate</i>, <i>transversal</i> and <i>alternate angles</i> to describe angles and shapes • use the above types of angles to determine unknown or missing angles

Sub-strand	Grade 6	Grade 7	Grade 8
Nets	<p>6.2.13 Construct nets of regular solids</p>	<p>7.2.13 Design nets for various solids</p>	<p>8.2.13 Associate nets with the solids they form</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • make nets of simple solids such as cubes, cuboids and prisms • construct solids from their nets 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • design and construct nets for cuboids, and simple prisms • make a net for a cone or pyramid 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • identify and make 3-dimensional shapes using various nets • construct the nets of various solid figures on squared papers, such as triangular prism, cylinder, rectangular prism • turn nets of solids such as cube, cuboid, prism and cylinder to their 3-dimensional shapes • differentiate between real nets and other 'non-net' patterns of flat shapes

Sub-strand	Grade 6	Grade 7	Grade 8
Direction	<p>6.2.14 Identify and use compass directions</p>	<p>7.2.14 Give the direction of a location relative to others as a bearing</p>	<p>8.2.14 Use and read maps accurately</p>
Indicators	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • identify and indicate the four main compass directions, North, South, West and East, and the intermediate points: NE, NW, SE and SW • follow directions given in terms of compass direction and distance travelled • locate a place on a map or in real life 	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • state direction accurately as a bearing • use appropriate compass directions to state a bearing accurately • determine a direction from a given bearing 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • construct a scale map of the local community or school, using suitable measurements of distances and directions • find places on a map quickly and be able to specify position on a map to others • use the key and scale to interpret maps • construct sketch maps to communicate location information clearly and efficiently

Sub-strand	Grade 6	Grade 7	Grade 8
Maps and Coordinates	<p>6.2.15 Use and make keys and scales on maps</p>	<p>7.2.15 Make maps having scales and keys from suitable data</p>	
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • demonstrate an ability to read and use a key • give the correct real distance from a map by applying the map scale 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • choose a scale suitable for making a map of their class room • make a map of their classroom using a suitable scale • create a suitable key to represent items in their classroom, on a map 	

Sub-strand	Grade 6	Grade 7	Grade 8
Maps and Coordinates	6.2.16 Use map grids and coordinates to locate points	7.2.16 Use a four-quadrant number plane	8.2.16 Use longitude and latitude to locate places on a map
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • identify locations on a map given grid references or coordinates • use number pairs as coordinate references 	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • plot points on a number plane by use of ordered pairs with positive and negative values • record the ordered pair coordinates of points shown on a four-quadrant number plane 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • locate a town or map feature by its latitude and longitude only in degrees and minutes • give latitude and longitude for a given locality to the nearest minute by reading from a suitable map

Strand : MEASUREMENT

Sub-strand	Grade 6	Grade 7	Grade 8
Weight	6.3.1 Use appropriate units for weights in measurements and calculations	7.3.1 Use charts and graphs to read and record weights and solve problems related to weight	8.3.1 Solve real life weight problems with confidence and competence
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use grams, kilograms or tonnes as appropriate for the quantity being measured • use addition, subtraction, multiplication and division to solve weight-related problems 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • plot data on a weight for age graph and comment meaningfully on the result • take a series of weight measurements to find an average weight • take tabulated price per cash crop unit weight to value a given weight of cash crop 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use a weight for age baby weight chart to read and record baby weights and comment as to health status based on that • use children's weight for age or height chart to determine their own ideal weight and to comment on their actual weight • use appropriate operations to solve problems involving weight • determine the yield for a cash crop given the average weight per hectare

Sub-strand	Grade 6	Grade 7	Grade 8
Weight		<p>7.3.2 Recognise weight as a force</p>	<p>8.3.2 Differentiate between weight and mass</p>
Indicators		<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • compare weight as a downward pull to other forces in other directions • measure the pull of weight as a force by use of springs, rubber bands or force meters 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • recognise that an object keeps its mass but can alter its weight depending on its location

Sub-strand	Grade 6	Grade 7	Grade 8
Temperature	6.3.3 Investigate temperature and the thermometer as a measuring instrument	7.3.3 Read a thermometer scale and compare measurements	8.3.3 Display temperatures including those from specialist thermometers
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • appropriately use the words <i>hot</i>, <i>cold</i> and <i>warm</i> to describe temperatures • offer reasonable estimates of air, water, and body temperature in degrees Celsius by feel: ± 5 degrees • use a thermometer to measure various temperatures in their environment • read the measurement off the thermometer scale accurately • recognise that thermometers can have negative numbers on its scale, giving temperatures colder than zero degrees Celsius: 0°C • read the temperature from a picture of a thermometer scale 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • measure air temperature and state how this compares to the daily average as given on an annual temperature graph for their area • measure water temperature and compare to tabulated temperatures 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • record temperatures from wet and dry bulb thermometers and use these to determine humidity from a chart • record body temperature to the nearest tenth of a degree using a clinical thermometer and compare this to normal body temperature • record daily maximum and minimum temperatures using a maximum and minimum thermometer and use these to establish long term temperature records

Sub-strand	Grade 6	Grade 7	Grade 8
Time	<p>6.3.4 Use a variety of time records</p>	<p>7.3.4 Manipulate time to solve problems</p>	<p>8.3.4 Recognise relationships between location and time</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use time lines, timetables, time schedules, diaries and calendars accurately 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve 'time remaining' or 'time since' problems involving hours and minutes • solve simple time-related problems 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • determine the time in other cities of the world based on the time difference with the time in Papua New Guinea

Sub-strand	Grade 6	Grade 7	Grade 8
Time			8.3.5 Use time-rate calculations
Indicators			<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use speed to determine distance travelled • use pay rates to determine pay earned

Strand: CHANCE AND DATA

Sub-strand	Grade 6	Grade 7	Grade 8
Statistics	6.4.1 Collect and interpret locally relevant statistical data	7.4.1 Compare sets of data	8.4.1 Interpret information presented statistically
Indicators	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • use surveys, questionnaires and interviews to collect interesting data from their community, school and class • collate data in tally tables • present data in bar graphs, pictograms or histograms • use an appropriate form of average, (mean, median, mode) to make suitable collective statements about their data • use the words <i>range</i>, <i>mean</i>, <i>median</i>, <i>mode</i> and <i>sample-size</i> with understanding • identify inappropriate interpretations of sets of data presented in the media 	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • explain the distinction between the three averages: mean, mode, median, as a measure of central tendency • interpret, construct and label graphs • draw and use frequency distribution tables • correctly interpret information presented in a variety of statistical graphs • apply relevant bar graphs, pictograms, histograms and pie charts to statistical information 	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • present collated data in tables and graphs: pictograms, column graphs, bar graphs, line graphs, time graphs, pie charts • interpret percentage increases over a period of time, such as population, mineral production, export and import statistics • calculate the three averages: mean, median and mode using given data • use results from a random sample to make prediction for future results

Sub-strand	Grade 6	Grade 7	Grade 8
Sets	6.4.2 Explore empty sets, intersections and unions	7.4.2 Use a variety of classification methods	8.4.2 Use sets to solve problems from real life
Indicators	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • define and recognise an empty set as a group with no members with a particular attribute • define and recognise intersection sets, when members belong to two or more sets • define and recognise union sets when all members are members of two groups • using Venn diagrams to solve problems 	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • classify objects up to three levels of attributes • identify examples of sets that have common attributes 	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • use Venn diagrams to illustrate classifications

Sub-strand	Grade 6	Grade 7	Grade 8
Probability	<p>6.4.3 Explore the results of independent events</p>	<p>7.4.3 Calculate probabilities from individual event probabilities</p>	<p>8.4.3 Explore the social implications of probability</p>
Indicators	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • identify possible outcomes from a particular event and the likelihood of these different events occurring in terms of <i>possible, impossible, certain</i> • describe and sequence events on a continuum of impossible, unlikely, equal chance, most likely, likely and certain • consider and describe probability in everyday events • investigate the effects of non random choice 	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • calculate and describe probabilities of everyday events • discuss situations that depend on chance 	<p>Students will be achieving this when, they for example</p> <ul style="list-style-type: none"> • explore and discuss the chances of losing and winning in games • discuss the social consequences of gambling • discuss the reasons people gamble and the consequences of promotional gambling • investigate the spread of gambling throughout most everyday activities • comment on the importance of chance in situations, such as job applications, course selections, examination results, health, crop production

Sub-strand	Grade 6	Grade 7	Grade 8
Error and Accuracy	<p>6.4.4 Discuss sources of error meaningfully</p>	<p>7.4.4 Apply strategies to reduce error</p>	<p>8.4.4 Combine error-reducing strategies to get the best results</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • consider errors caused by rounding to the nearest scale unit • consider errors caused by the accuracy of tools used • consider errors caused by the competence of a person using tools • consider errors caused by changes to the material being measured • consider errors caused by errors introduced by calculation 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use appropriate measuring tools reliably • reduce parallax error • make repeated measurements and average results 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • apply a variety of error-reducing strategies • recognise errors and take steps to reduce the effects of these errors

Sub-strand	Grade 6	Grade 7	Grade 8
Accuracy and Error	6.4.5 Discuss the value of accuracy	7.4.5 Choose appropriate levels of accuracy	8.4.5 Represent levels of accuracy
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none">• consider the need to order more materials than required and the cost implications• talk about the consequences of inaccurate measurements	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none">• measure to suitable levels of accuracy as required for the task	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none">• use conventions such as \pm amount or \pm percentage to bracket errors• use error bars on graphical representations

Sub-strand	Grade 6	Grade 7	Grade 8
Estimation	<p>6.4.6 Estimate quantities and numbers</p>	<p>7.4.6 Use a variety of estimation strategies</p>	<p>8.4.6 Identify and select appropriate estimation strategies</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • make estimates of quantities before measurement to within $\pm 20\%$ • use estimates of quantities to check the validity of measurements they make • estimate expected results of calculations and use these to check the validity of their calculations 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • estimate by comparison to other familiar quantities and items • estimate by dividing into manageable parts 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use estimation strategies that give consistently close results when compared to measurements • estimate consistently to better than $\pm 10\%$

Sub-strand	Grade 6	Grade 7	Grade 8
Estimation	6.4.7 Round off amounts	7.4.7 Estimate sums of money	8.4.7 Estimate results of calculations
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • round fractions of a toea to the nearest whole toea • round money to the nearest whole Kina • round lengths to the nearest 1 cm, 10 cm, 1 m, 10 m, 100 m, 1 km as appropriate • round other measurements to suitable place value 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • give a close value after a quick inspection of a number of coins and notes spread on a table • use mental approximations to estimate a price per kilogram given a price for 750 g 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • use rounding and other appropriate methods to obtain an approximate answer to a calculation • use estimated results where the exact answer is not necessary • compare estimated results with exact results to check validity of results

Strand : PATTERNS AND ALGEBRA

Sub-strand	Grade 6	Grade 7	Grade 8
Packing	6.5.1 Identify different methods used for packing	7.5.1 Use different packing patterns to pack objects	8.5.1 Apply packing patterns in solving problems from real life
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • discuss and use packing concepts • identify packing patterns, tree plantings and spacing of other cash crops, such as triangular spacing and square spacing of cash crop trees 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • pack cylinders (cans or jars) to achieve highest number on a given shelf space • arrange spheres in a three dimensional pattern that is stable • use a square and triangular array to plant seedlings in a field or tray 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • solve real life problems by identifying the best packing strategies and using them to pack various goods

Sub-strand	Grade 6	Grade 7	Grade 8
Algebra	6.5.2 Explore number patterns	7.5.2 Relate number patterns and algebraic statements	8.5.2 Recognise and use patterns in processes
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • identify number patterns such as triangle numbers, square numbers, Fibonacci series, various arithmetic and geometric series • find the next term in a series—with justification • create a number pattern from their own stated rule 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • describe number patterns by using an algebraic expression • make number patterns given a simple algebraic expression 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • apply similar patterns to new situations to solve problems • apply process patterns in problem solving

Sub-strand	Grade 6	Grade 7	Grade 8
Algebra	<p>6.5.3 Introduce pronumerals</p>	<p>7.5.3 Substitute numbers for pronumerals</p>	<p>8.5.3 Manipulate simple algebraic expressions and solve real life problems</p>
Indicators	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • evaluate a pro-numeral in a number sentence • make up a rule to describe a number pattern and use pronumerals in the rule 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • substitute pronumerals with numerals in simple equations 	<p>Students will be achieving this when they, for example</p> <ul style="list-style-type: none"> • simplify simple algebraic expressions • use distributive laws to expand algebraic expressions • identify factors • identify common factors • solve simple algebraic expressions by substitution, • apply problem solving equations to solve problems

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