Mathematics

Upper primary

Syllabus 2003

Section 1

Curriculum Information

Papua New Guinea
Department of Education

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Acknowledgements

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Secretary's Message

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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.

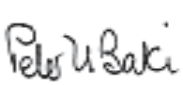
The Upper Primary Mathematics Syllabus contributes significantly towards achieving Integral Human Development. Without a sound working knowledge of mathematics, a person's ability to function effectively is severely restricted. This course is designed to promote both a firm understanding of practical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

Introduction

This syllabus makes explicit the knowledge, skills, attitudes and values that students should achieve for Grades 6, 7 and 8 in Mathematics. These are expressed as learning outcomes and indicators.

The learning outcomes are student centred and written in terms that enable them to be demonstrated, assessed or measured. The outcomes are written to show a progression from one grade to the next.

Each learning outcome is illustrated with a list of examples of the kinds of things students should be able to do, know and understand if they are achieving an outcome. These are called indicators.

The learning outcomes and indicators will:

- give teachers individually or collaboratively, the flexibility to write programs and units of work—these can be developed to suit local conditions and individual student needs,
- help teachers assess and report students' achievements in relation to the learning outcomes,
- allow student achievement of the outcomes to be described in consistent ways,
- help teachers to monitor student learning,
- help teachers plan their future teaching programs.

This Upper Primary Mathematics Syllabus reflects a significant step forward as part of the Education Reform. It presents a coherent view of the course at the Upper Primary level of schooling. It will also be useful to developers of support materials, planners and teachers of Grades Five and Nine.

Flowing from Lower Primary, Mathematics at Upper Primary level focuses on developing numerical, analytical and investigative skills to solve real life problems likely to be encountered in their culture and community. Furthermore, it will provide a sound foundation for future mathematical studies and provides the mathematical literacy necessary to do other studies.

English is the main language of instruction and a vernacular language or a lingua franca will be used as required to enhance understanding of the mathematical concepts.

Students commencing this course will be competent in basic number facts and have a sound working knowledge of mathematical forms such as place value, the four operations and standard symbols.

Teachers teaching this course will be generalist teachers using the Syllabus, Teachers Guide and other support materials to present this course.

Mathematics is to be timetabled for 180 minutes per week in all Upper Primary schools.

Rationale

All citizens of Papua New Guinea have the right to participate fully in all aspects of development and self-determination. To this end a sound mathematical literacy is essential.

An all encompassing view of Mathematics and the whole curriculum is needed to maximise the gain to the students, as the solutions to life problems will not come from neatly separated skills but from the whole of their ability.

By linking new mathematical concepts to existing cultural and scholastic knowledge, the students integrate knowledge so that they are more able to use it in their lives.

The use of familiar and interesting contexts reduces the dissatisfaction often associated with Mathematics and makes clear the processes as students work out solutions to familiar and relevant problems.

Mathematics, as any knowledge area, can be abused and used unethically. Often those with the capacity to do so misuse mathematical information to confuse, decieve or threaten the less knowledgable. The best defence against this abuse is a mathematically literate population.

There are pressing social issues in Papua New Guinea regarding population growth, inequitable distribution of resources, corruption and compensation demands which cannot be fully debated without an understanding of the underlying mathematics.

The potential for misconceptions or deliberate incorrect information is enormous. This course teaches much of the mathematics needed to understand these issues and thus allows the next generation to take steps to begin to correct these problems.

The content of this course has been chosen specifically to provide a solid mathematical literacy both for those leaving the system of formal education at Grade Eight and those remaining. The course provides a solid foundation on which further learning can be built and provides a glimpse into the elegance of mathematical thought.

Papua New Guinean society is changing rapidly, as are the needs of its citizens. Everyday life requires individuals to have an ever increasing mathematical ability to participate fully.

In matters of buying, selling, earning an income, building a house, making a meri blouse or even interpreting political statements, sound mathematical reasoning skills are required. Therefore it is important that our Mathematics curriculum caters for these changing needs, especially in the area of numeracy. This course addresses this by making the mathematics more relevant and more accessible to students.

Curriculum Principles

This course is based on three fundamental learning principles:

- we learn best when we build new learning on what is already known,
- we learn well when we recognise an immediate use or need for what is to be learned,
- we use many different ideas and skills in a coordinated way to solve real problems.

The course continually refers to pre-existing knowledge, setting the mathematics into contexts that are familiar and of interest to the students. The contextual approach leads to real problems in interesting and familiar settings requiring students to participate in both problem-setting and problem-solving processes.

The students need to use concepts and skills from many areas of mathematics and other sources to come up with workable solutions, as in real life. This approach facilitates a student-based mode of learning.

Catering for Diversity

In using a contextual approach, it is vital that the contexts used do not unduly favour one gender over the other. Special attention needs to be given to balancing the contexts to give both males and females equal opportunity. In this instance, a simple majority choice may not be appropriate where there is a gender imbalance in the numbers of students in the class.

While student participation in the choice of contexts may be desirable, it is part of the teacher's role to ensure all students in the class have a fair opportunity to progress and learn. Most contexts are sufficiently broad so that with a little planning and forethought, gender equity can be maintained.

Teaching and Learning

In Primary schools, generalist teachers often prefer to use an integrated approach to teaching and learning. The teacher creates a program that is meaningful, appropriate, engaging and motivating to the students. The use of learning outcomes provides opportunities to integrate the curriculum.

Teachers should map out the learning outcomes for those parts of the syllabus that they are intending to teach in the coming term or year. Where there is more than one teacher across a grade, this should be done as a small team.

Teachers in the school with leadership responsibilities should be invited to attend and support this planning process. While carrying out this process links between learning outcomes for different subjects should be noted, as there is scope for combining and using these outcomes in an integrated approach to teaching.

For example, a Language learning outcome might refer to the use of questionnaires and holding discussions with community members and a Making a Living learning outcome may also do this. In this way evidence of the achievement of these outcomes can be provided in more than one subject.

Teaching Approaches in Mathematics

The teaching approaches required for this course are student-centred learning activities. They promote the philosophy of 'how to think', not 'what to think'. The student-centred teaching activities include investigation, problem solving and out-of-class excursions.

These provide opportunities for students to work cooperatively, to discuss, make decisions, plan, organise, carry out activities, record results and report findings. Activities should also allow the students to listen to each other's opinions, demonstrate their strategies and critically analyse results.

The teaching and learning of concepts promotes the philosophy of 'known to unknown', building on what the students know and teaching concepts using similar contexts for better understanding. The teaching and learning approaches must be student centred and as much as possible, student directed.

Bilingual Education

While it is recognised that English is the main language of instruction it must also be recognised that students are still more familiar with their vernacular or lingua franca and the teacher should encourage their use where it will lead to better understanding.

Since Mathematics is itself a language and one different from any other language, it is believed that the use of their first language will help the students to understand better when dealing with mathematical activities.

Multigrade Teaching

The contextual approach used for this course lends itself to multigrade teaching as the same context can be used for all students in the multigrade classroom with the more advanced students tackling more sophisticated work and those less advanced addressing similar issues at another level.

Teachers of multigrade classes will need to plan their program of work carefully so that students do not repeat the same contexts, and so that students progress through the skill stages presented in the outcomes. It is best if the same teacher remains with the multigrade class over the number of years represented in that class. If this is not possible, then the replacement teacher will need to use the programs of the previous teacher for writing new programs.

Integration

Some topics or teaching strategies in the Upper Primary Mathematics course are also dealt with in other subject areas. These topics include measuring, drawing, classifying, collecting and presenting data, graphing, time, money, decimals and percentages.

The skills and knowledge taught in Mathematics are used widely in other subject areas. Contents from other subjects provide suitable contexts in which to teach Mathematics. For example, if the students are studying ‘budgeting’ or ‘running a small business’ in Making a Living, this would tie in with ‘Decimals and Percentages’ in Mathematics.

This course is designed to be taught with a need for flexibility in programming. While it is necessary for a few of the topics to be taught in sequence the majority of the course can be taught in any order that suits the needs of other subjects. Teachers are advised to take advantage of this to maximise the links between subjects.

Aims

Students:

- develop, extend, link and demonstrate the concepts, skills and attitudes flowing from Lower Primary Mathematics,
- develop numerical, analytical and investigative skills to solve real life problems likely to be encountered in the culture and community of Papua New Guinea,
- develop a sound foundation for further mathematical learning,
- develop confidence in applying mathematical skills,
- develop curiosity leading to the understanding of concepts,
- develop determination to persist with difficult problems,
- develop critical judgement in selecting approaches to problems and appreciation of the cultural diversity in numeracy,
- understand information in graphical, statistical and written forms,
- master numeracy and manipulative skills in presenting information by drawing, illustrating, identifying, comparing, measuring, calculating and graphing,
- become more competent members of society,
- evaluate mathematical data in a sensible fashion and present meaningful information to further their own and their communities' needs.

Content Overview

The content for this syllabus is organised into five Strands. A Strand such as Number and Application is a useful and convenient way of organising the learning outcomes for a subject.

Each Strand identifies a particular aspect of a subject or a particular theme such as a set of processes. Each Strand displays a typical progression of learning from one grade to the next.

Each Strand is further organised into a number of Sub-strands to allow the content to be specified and described as learning outcomes.

Mathematics has five Strands: Number and Application, Space and Shape, Measurement, Chance and Data and Patterns and Algebra.

Number and Application has seven Sub-strands: Fractions, Decimals, Fractions and Decimals, Decimals and Percentage, Ratios and Rates, Directed Numbers and Indices.

Space and Shape has nine Sub-strands: Length, Area, Volume, Shape, Tessellations, Angles, Nets, Direction and Maps and Coordinates.

Measurement has three Sub-strands: Weight, Temperature and Time.

Chance and Data has five Sub-strands: Statistics, Sets, Probability, Accuracy and Error and Estimation.

Patterns and Algebra has two Sub-strands: Packing and Algebra.

Number and Application

Students use all common forms of number including fractions, decimals percentage, indices and negative numbers. They apply these to solve real problems which might be encountered in ordinary life.

Space and Shape

Students estimate and measure length, area, volume and angle. They learn the language required to discuss shape and direction. They learn to locate points on a plane by way of coordinates. They are presented with practical applications of what they are learning. Throughout they are challenged to apply a broad range of mathematics to solve problems.

Measurement

This strand concentrates on the units and practice of measuring weight, temperature and time. Students record, calculate and present measurements they make.

Chance and Data

In this strand the collection, presentation and interpretation of data is stressed. This strand deals with statistical information, graphs, probability and sets. It also considers methods of estimation and issues of accuracy and error.

Patterns and Algebra

This strand deals with patterns in packing, in number and operations. These are used to link common events to mathematical thought and the idea of abstract representation of numbers and processes that is possible with algebra.

Knowledge, Skills and Attitudes

Knowledge—students will:

- recognise, identify, discuss, formulate, understand, analyse and evaluate each of the mathematic strands,
- apply the content in everyday practical situations,
- demonstrate an understanding of the four operations: addition, subtraction, multiplication and division, and be able to solve ordinary practical problems involving mathematics.

Process skills—students will:

- classify, estimate, predict, and perform the four operations of adding, subtracting, multiplying, division,
- locate, compare, sort, order, interpret, and present information including graphical, tabular, drawn, written and numerical,
- round off numbers and formulate rules or formulae,
- explore and investigate practical problems,
- manage, plan and solve problems.

Motor skills—students will:

- manipulate and sort materials,
- translate and transfer mathematical information,
- model, measure and classify practical mathematical problems,
- demonstrate technical drawing and mapping skills.

Life skills—students will:

- read, analyse, abstract, extract, comprehend, research and think critically,
- use calculators to solve practical mathematical problems and to apply knowledge and skills.

Attitudes—students will:

- value, appreciate and enjoy learning Mathematics,
- appreciate that mathematics is in their environment or daily activities,
- develop inquisitive minds to investigate and develop good work and study habits,
- develop a mutual respect for one another's ideas and opinions.

Table of Strands and Sub-strands for Mathematics

Strand	Grade 6	Grade 7	Grade 8
Number and Application	• fractions • decimals • fractions and decimals • decimals and percentage • ratios • directed numbers • indices	• fractions • decimals • fractions and decimals • percentage • ratios, fractions and rates • directed numbers • indices	• fractions • decimals • fractions and decimals • percentage • ratios and rates • directed numbers • indices
Space and Shape	• length • area • volume and capacity • shape • tessellations • angles • nets • direction • maps and coordinates	• length • area • volume and capacity • shape • tessellations • angle • nets • direction • maps and coordinates	• length • area • volume and capacity • shape • tessellation • angle • nets • maps

Strand	Grade 6	Grade 7	Grade 8
Measurement	• weight • temperature • time	• weight • temperature • time	• weight • temperature • time
Chance and Data	• statistics • sets • probability • accuracy and error • estimation	• statistics • sets • probability • accuracy and error • estimation	• statistics • sets • probability • accuracy and error • estimation
Patterns and Algebra	• packing • algebra	• packing • algebra	• packing • algebra

Assessment and Reporting

Assessment and reporting practices described here are detailed further in *The Assessment and Reporting Policy for Papua New Guinea* and in other support materials produced by the Department of Education.

Assessment

Assessment is the ongoing process of identifying, gathering and interpreting information about students' progress towards achievement of the learning outcomes described in the subject syllabuses.

Teachers record evidence of students' learning and use it to make judgements about students' achievements of the learning outcomes. To ensure that assessment is fair and balanced, teachers should use a range of assessment methods including:

- observing and recording details of students' demonstration of process skills and/or their performance on particular tasks,
- setting written assignments, projects and practical work,
- setting and marking written tests and/or examinations,
- keeping portfolios of students' work.

Teachers should provide opportunities for students to assess their own learning (self-assessment) and the learning of others (peer assessment) according to set negotiated criteria. The purpose of assessment is to improve student learning.

Assessment is the process of finding out what the children know. Evaluation is the comparison of the results of assessment against predetermined criteria. To do this effectively it is necessary to record the assessment information. Finally there is little purpose in carrying out any of these things if the results of the evaluation are not reported on and the report acted upon.

Assessment in Mathematics

Assessment should first and foremost be used to evaluate student performance so that teaching can be adjusted to improve the students' performance. Assessment is thus to help the teacher to provide better learning opportunities for the students and to help the teacher adjust the program of instruction to ensure that desired outcomes are achieved. To do this well assessment must be continuous throughout the year. A little often is far better than a lot sometimes.

Written tests and examinations assess a small part of this course. If teachers only use written tests they will overlook important parts of the course.

The emphasis should be on teaching mathematics for understanding. Written tests should not be the only method used to find out what the students have learnt. Other forms of internal assessment must also be used.

Recommended Assessment Strategies

These are some strategies or techniques that teachers can use to assess students performance in Mathematics lessons:

Observing students during the lesson:

Making informal observations and keeping notes of these on a class list. Choose just one or two students in any one lesson and note down both positive and negative things they do during that lesson. Continue with different students until you have some comments on all students, then repeat the process.

Talking with students:

Use both good questioning techniques in class and informal discussions with individual students to get a picture of each student. Relevant points from such talks must be noted down, such as whether or not the correct mathematical terms were used to answer a question, or whether or not the student showed understanding of a concept. Formal interviews may also provide further information.

Profiles:

Teachers may set a series of mini projects or exercises and keep samples of work from each student on file, maintaining a folder of work for each student. Student exercise books fulfil this function to some extent. Examination of students' exercise books can give a good indication of the students' level of understanding especially if the work in their books is their own and not copied from the board.

Another form of maintaining such profiles is to only retain the best and latest version of their work. For instance, a student may not have demonstrated an ability to carry out long division in March, but in June does do so. Under this approach only the work produced in June will be kept, demonstrating that that particular outcome has been achieved.

Checklists:

Create a checklist of all the expected outcomes for the year and list these against the students' names. As each student demonstrates achievement of the outcome, check that outcome off on the list against that student's name.

Tests:

These may be short answer or longer exercises. They may be open book or strictly from memory. There are many possibilities. Multiple-choice tests are the most difficult to write well. Those written for examinations undergo a rigorous trialing and editing before use and even then do not always achieve what was intended. Teachers are advised to use other types of questions.

Regular short tests, both written and oral, will provide more relevant up-to-date information to alter teaching than longer infrequent tests. An end of unit test does not give the teacher the information needed to change their approach to that unit until it is too late. A ten-minute quick quiz every week can provide timely clues to the success or failure of a teaching strategy.

Keeping records of practical work:

These may include models students have made, assignments they have completed and any other work that demonstrates their present ability.

Reporting

Teachers must keep accurate records of students' achievement of the learning outcomes and report these achievements in fair and accurate ways to parents and guardians, teachers, students and others. Recording methods will include the following:

- journal, diary or anecdotal notes,
- portfolios,
- progressive records,
- checklists,
- work samples with comments written by the teacher.

Student reports should be based on assessment information collected from ongoing assessments and where appropriate, from external examinations (Grade 8). Schools will decide on how reports will be presented to best suit the needs of their communities.

Evaluation

Teachers will use assessment information to evaluate the effectiveness of their teaching, learning and assessment programs and to make improvements to their teaching practice in order to improve student learning.

Schools may use whole school assessment data to evaluate the effectiveness of teaching and learning in a particular subject or at particular grade levels and make decisions on how to improve student learning.

Mathematics

Upper primary

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Section 2

Learning outcomes and indicators

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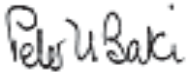

Peter M. Baki
Secretary for Education

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

Strand	Grade 6	Grade 7	Grade 8
Space and Shape	**6.2.9** Draw and investigate properties of polygons	**7.2.9** Draw, investigate and make physical models of quadrilaterals	**8.2.9** Make physical models of circles and investigate their properties
	6.2.10 Make tessellations using regular shapes	**7.2.10** Create irregular shapes that tessellate	**8.2.10** Investigate rotational tessellations
	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
		7.2.12 Construct and determine properties of angles	**8.2.12** Use appropriate words to identify and describe angles and shapes accurately
	6.2.13 Construct nets of regular solids	**7.2.13** Design nets for various solids	**8.2.13** Associate nets with the solids they form
	6.2.14 Identify and use compass directions	**7.2.14** Give the direction of a location relative to others as a bearing	**8.2.14** Use and read maps accurately
	6.2.15 Use and make keys and scales on maps	**7.2.15** Make maps having scales and keys, from suitable data	
	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

Strand	Grade 6	Grade 7	Grade 8
Measurement	**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
		7.3.2 Recognise weight as a force	**8.3.2** Differentiate between weight and mass
	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
	6.3.4 Use a variety of time records	**7.3.4** Manipulate time to solve problems	**8.3.4** Recognise relationships between location and time
			8.3.5 Use time-rate calculations
Chance and Data	**6.4.1** Collect and interpret locally relevant statistical data	**7.4.1** Compare sets of data	**8.4.1** Interpret information presented statistically
	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
	6.4.3 Explore the results of independent events	**7.4.3** Calculate probabilities from individual event probabilities	**8.4.3** Explore the social implications of probability
	6.4.4 Discuss sources of error meaningfully	**7.4.4** Apply strategies to reduce error	**8.4.4** Combine error-reducing strategies to get the best result

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'.	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • solve problems such as $12\ ^{1}/_{4} \times\ ^{1}/_{2}$ • solve problems like $12^{1}/_{2} \times 0.25$ 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	**6.1.2** Add, subtract multiply and divide decimals	**7.1.2** Use decimals in solving problems set in familiar contexts	**8.1.2** Use decimals to solve real life problems
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• solve problems such as 0.320 + 1.162, 2.711 - 1.304 • solve problems such as 3.162 x 4, 2.255 ÷ 3 • solve problems such as one metre of material costs K5.25, how much do 5 metres cost?	• solve problems such as 0.115 - 2.015, 12.101 - 6.0009 • solve problems such as 2.1115 x 5, 3.002 x 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	• solve problems from real life situations • present data in decimal format accurately

Sub-strand	Grade 6	Grade 7	Grade 8
Fractions and Decimals	**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
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• change $^1/_2$ to 0.5, $^1/_4$ to 0.25, $^3/_4$ to 0.75, $^3/_{10}$ to 0.3, and $^4/_{10}$ to 0.4 • change for example 0.5 to $^1/_2$, 0.32 = $^{32}/_{100}$ = $^8/_{25}$	• change 3/8 to 0.375 to $37^1/_2$% or 37.5% (avoid fractions which lead to repeating decimals) • change 2.015 to $^{2015}/_{1000}$ = $^{403}/_{200}$ to 201.5% or $201^1/_2$%	• change 60% to $^{60}/_{100}$ = $^6/_{10}$ = to 0.60 • change 75% to 3:4 to $^3/_4$ to 0.75 • change 50% to $^1/_2$ 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 x K15) = K15 + K1.50 = K16.50

Grade 7	Grade 8		
Decimals and Percentages	**6.1.4** Link fractions and decimals to percentages and solve simple percentage problems	**7.1.4** Use percentage in a variety of real life situations	**8.1.4** Solve problems in any situation that involves percentages
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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 $^1/_{10}$, $^1/_5$, $^1/_4$, $^1/_2$, $^3/_4$ 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	• 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?'	• solve problems involving percentages that would be encountered in a trading situation

Sub-strand	Grade 6	Grade 7	Grade 8
Ratios and Rates	**6.1.5** Recognise ratios	**7.1.5** Convert between ratios and fractions	**8.1.5** Apply ratios in solving problems from real life
Indicators	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • change 3:7 to $^{3}/_{10}$:$^{7}/_{10}$ where 10 = 3+7 • simplify 8:12 by dividing common factor, such as 8:12 = 2:3 or changing ratios to fractions 8:12 = $^{8}/_{12}$ = $^{2}/_{3}$ and $^{8}/_{20}$ = $^{2}/_{5}$ and $^{2}/_{5}$ = 2:5	Students will be achieving this when they, for example • 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		**7.1.6** Recognise and relate rates to graphs Students will be achieving this when they, for example • 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 $^{3}/_{5}$ m/s or 0.6 m/s	**8.1.6** Apply rates to solve simple problems from real life Students will be achieving this when they, for example • 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	**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
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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	• determine solutions to problems by use of number lines, counters or other aids, positive or negative	• solve problems such as 3-5, -2 x 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	**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
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• calculate solutions to numbers such as 3^2, 4^3 • express products like 4 x4 as 4^2, 9 x 9 as 9^2, 3 x 3 x 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	• calculate numbers such as 2^5, 3^4 • express products like 3 x 3 x 3 x 3 x 3 as 3^5	• 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 $6^{-3} = {}^1/_{6^3}$ • 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	**6.2.1** Estimate, measure and compare using metric units	**7.2.1** Estimate and measure using metric units and lengths from maps and other sources	
Indicators	Students will be achieving this when they, for example • 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: ± 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	Students will be achieving this when they, for example • estimate lengths in metres and kilometres to within ±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	**6.2.2** Convert between metric units of length and round off	**7.2.2** Use appropriate metric units in calculations	
Indicators	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • 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	**6.2.3** Calculate the perimeter of shapes	**7.2.3** Investigate and measure the circumference of circles	
Indicators	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • 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 ± 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	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • distinguish areas differing by as little as 10% through visual inspection and estimation only • regularly make estimates of areas accurate to ±10% before calculation and compare these to the calculated value to verify the calculation	

Sub-strand	Grade 6	Grade 7	Grade 8
Area	**6.2.5** Investigate and use area rules for triangles and rectangles	**7.2.5** Investigate area rules for quadrilaterals	**8.2.5** Investigate the area of circles
Indicators	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • solve the area of trapeziums, kites, parallelograms and rhombuses by suitable rules • solve areas of irregular quadrilaterals by treating them as compound shapes	Students will be achieving this when they, for example • 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	**6.2.6** Investigate volumes of simple solids to determine rules	**7.2.6** Investigate volumes of compound prismatic solids and use rules to determine volumes	**8.2.6** Investigate volumes of cylinders, cones and pyramids and apply some volume rules
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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	• 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	• 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	**6.2.7** Investigate capacity	**7.2.7** Investigate the relationship between capacity and volume	**8.2.7** Apply capacity and volume measurements in problem solving
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• Compare the capacity of different shaped containers by measuring the capacity in mL or L as appropriate, using measuring cups or cylinders	• 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	• Convert freely between capacity and volume measures during the problem-solving process as convenient

Sub-strand	Grade 6	Grade 7	Grade 8
Capacity	**6.2.8** Convert between metric units	**7.2.8** Use appropriate units for capacity and solve capacity problems	**8.2.8** Convert between a variety of units: capacity and volume, and metric and imperial
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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	• 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	• 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	**6.2.9** Draw and investigate properties of polygons	**7.2.9** Draw, investigate and make physical models of quadrilaterals	**8.2.9** Make physical models of circles and investigate their properties
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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	• 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	• 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	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• make tessellations using regular shapes cut from paper or card • draw tessellations using regular shapes • distinguish between tessellating and non-tessellating regular shapes	• 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 irregula • create interesting shapes that tessellate	• 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	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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	• 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	• 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
Angles		**7.2.12** Construct and determine properties of angles	**8.2.12** Use appropriate terms to describe angles and shapes accurately
Indicators		Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • use words such as *complementary, supplementary, corresponding, co-interior, exterior, alternate, transversal* and *alternate angles* 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	**6.2.13** Construct nets of regular solids	**7.2.13** Design nets for various solids	**8.2.13** Associate nets with the solids they form
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• make nets of simple solids such as cubes, cuboids and prisms • construct solids from their nets	• design and construct nets for cuboids, and simple prisms • make a net for a cone or pyramid	• 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	**6.2.14** Identify and use compass directions	**7.2.14** Give the direction of a location relative to others as a bearing	**8.2.14** Use and read maps accurately
Indicators	Students will be achieving this when, they for example	Students will be achieving this when, they for example	Students will be achieving this when they, for example
	• 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	• state direction accurately as a bearing • use appropriate compass directions to state a bearing accurately • determine a direction from a given bearing	• 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	**6.2.15** Use and make keys and scales on maps	**7.2.15** Make maps having scales and keys from suitable data	
Indicators	Students will be achieving this when they, for example • demonstrate an ability to read and use a key • give the correct real distance from a map by applying the map scale	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example	Students will be achieving this when, they for example	Students will be achieving this when they, for example
	• identify locations on a map given grid references or coordinates • use number pairs as coordinate references	• 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	• 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	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• use grams, kilograms or tonnes as appropriate for the quantity being measured • use addition, subtraction, multiplication and division to solve weight-related problems	• 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	• 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		**7.3.2** Recognise weight as a force	**8.3.2** Differentiate between weight and mass
Indicators		Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• appropriately use the words *hot, cold* and *warm* 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 then zero degrees Celsius: 0°C • read the temperature from a picture of a thermometer scale	• 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	• 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	**6.3.4** Use a variety of time records	**7.3.4** Manipulate time to solve problems	**8.3.4** Recognise relationships between location and time
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• use time lines, timetables, time schedules, diaries and calendars accurately	• solve 'time remaining' or 'time since' problems involving hours and minutes • solve simple time-related problems	• 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			Students will be achieving this when they, for example • 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	Students will be achieving this when, they for example	Students will be achieving this when, they for example	Students will be achieving this when, they for example
	• 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 *range, mean, median, mode* and *sample-size* with understanding • identify inappropriate interpretations of sets of data presented in the media	• 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	• 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	Students will be achieving this when, they for example	Students will be achieving this when, they for example	Students will be achieving this when, they for example
	• 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	• classify objects up to three levels of attributes • identify examples of sets that have common attributes	• use Venn diagrams to illustrate classifications

Sub-strand	Grade 6	Grade 7	Grade 8
Probability	**6.4.3** Explore the results of independent events	**7.4.3** Calculate probabilities from individual event probabilities	**8.4.3** Explore the social implications of probability
Indicators	Students will be achieving this when, they for example	Students will be achieving this when, they for example	Students will be achieving this when, they for example
	• identify possible outcomes from a particular event and the likelihood of these different events occurring in terms of *possible, impossible, certain* • 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	• calculate and describe probabilities of everyday events • discuss situations that depend on chance	• 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	**6.4.4** Discuss sources of error meaningfully	**7.4.4** Apply strategies to reduce error	**8.4.4** Combine error-reducing strategies to get the best results
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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	• use appropriate measuring tools reliably • reduce parallax erro • make repeated measurements and average results	• 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	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• consider the need to order more materials than required and the cost implications • talk about the consequences of inaccurate measurements	• measure to suitable levels of accuracy as required for the task	• use conventions such as ± amount or ± percentage to bracket errors • use error bars on graphical representations

Sub-strand	Grade 6	Grade 7	Grade 8
Estimation	**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
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• make estimates of quantities before measurement to within ± 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	• estimate by comparison to other familiar quantities and items • estimate by dividing into manageable parts	• use estimation strategies that give consistently close results when compared to measurements • estimate consistently to better than ±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	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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	• 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	• 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	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• 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	• 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	• 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	Students will be achieving this when they, for example • 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	Students will be achieving this when they, for example • describe number patterns by using an algebraic expression • make number patterns given a simple algebraic expression	Students will be achieving this when they, for example • apply similar patterns to new situations to solve problems • apply process patterns in problem solving

Sub-strand	Grade 6	Grade 7	Grade 8
Algebra	**6.5.3** Introduce pronumerals	**7.5.3** Substitute numbers for pronumerals	**8.5.3** Manipulate simple algebraic expressions and solve real life problems
Indicators	Students will be achieving this when they, for example	Students will be achieving this when they, for example	Students will be achieving this when they, for example
	• evaluate a pro-numeral in a number sentence • make up a rule to describe a number pattern and use pronumerals in the rule	• substitute pronumerals with numerals in simple equations	• 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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