Mathematics

Lower Primary
Teacher Guide

Department of Education

Contents

Inservice units

A set of inservice units has been written to support the implementation of the primary reform curriculum. These units should be used in conjunction with the Lower Primary Mathematics Syllabus and this Teacher Guide. For further information contact your head teacher or district inspector.

The inservice units are:

*   self-instructional, so you can access them according to your needs
*   self-paced, so you can study at your own pace
*   outcomes-based, so you can experience outcomes-based approaches to education
*   based on adult principles of learning, such as doing, sharing and reflecting
*   practical and related to your daily work as a teacher or a supervisor
*   collegial, so you can learn together in small groups, whole school or cluster settings
*   accredited with the Papua New Guinea Education Institute, so you can improve your qualifications
*   designed to promote best practice, so you can effectively implement the curriculum
*   applicable across both Lower and Upper Primary syllabuses.

These units integrate principles contained in the National Curriculum Statement (2002) and the National Assessment and Reporting Policy (2003).

Secretary's message

The Mathematics Syllabus and this Teacher Guide build upon the skills and knowledge that children bring from their own cultural and family experiences and the learning outcomes of the Elementary curriculum. This learning occurs in the child's first language.

A bilingual approach is used in Lower Primary. It incorporates bridging to English processes in Grades 3, 4 and 5. This approach helps students to know who they are by building on their knowledge about their culture and first language.

The students' first language, used in Elementary, will continue to be the language of instruction while bridging to English takes place in Grades 3, 4 and 5. Students will continue to develop their thinking and decision-making skills as well as skills in speaking and listening, reading and writing in the language they speak, while also learning in English.

Lower Primary teachers are generalist teachers and this Teacher Guide is for all teachers in Lower Primary schools. It is one of a set of seven guides written for teachers of Grades 3, 4 and 5.
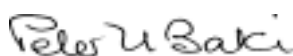
The emphasis in Lower Primary Mathematics is on student-centred learning, with a focus on active participation through investigating and problem-solving activities. Students will use concrete materials to help them solve problems.

Teachers must provide a classroom environment for Mathematics that encourages creativity and enjoyment. When planning, relate Mathematics activities and problems to relevant, real life situations. Teaching mathematical concepts in meaningful contexts and having hands-on experience assists students to understand the concepts.

Teachers are encouraged, where appropriate, to integrate Mathematics skills and content across the whole curriculum.

Teachers are also encouraged to read this guide carefully and then become familiar with the content of each of the other Lower Primary teacher guides. In this way, teachers can feel confident to try out the ideas and strategies that they believe will be effective with their students. Teachers may choose to modify and amend these ideas to suit local circumstances.

Teachers should work closely with members of their school communities, to ensure that local community needs are met within the framework of the learning outcomes published in the Lower Primary syllabuses.

PETER M. BAKI, CBE
Secretary for Education

Introduction

Purpose

This Teacher Guide must be used in conjunction with the Lower Primary Mathematics Syllabus. Its main purpose is to help you to implement the syllabus in your classroom.

The guide provides you with guidelines and directions to help you plan and develop teaching and learning activities for the achievement of the learning outcomes. It also provides you with information and processes to:

- use the elaborations to identify relevant content (knowledge, skills and attitudes) and contexts
- develop units of work based on clusters of learning outcomes relevant to your students' needs and interests
- select appropriate teaching and learning strategies
- plan a program suitable to your school
- plan and conduct assessment to monitor students' learning, and achievement of learning outcomes.

Using this teacher guide

When you receive your Lower Primary syllabuses and teacher guides, you need to do the following:

- read each teacher guide carefully
- become familiar with each syllabus, its strands and substrands
- select one subject, then read the outcomes and indicators for that subject
- read each section of that subject's teacher guide again and take note of those ideas, strategies and processes that you think will be useful to you
- repeat these steps for the other subjects
- meet with other teachers, share your ideas and plan how you will work together to write programs and units of work
- be ready to try out some of the units of work in the teacher guides
- be confident to write your own programs and units of work using the information in one or more of the teacher guides and subject syllabuses.

Bilingual education

Bilingual education is the regular use of two languages for instruction. With over 800 different languages spoken across Papua New Guinea, most students do not speak English as their first language. In Lower Primary Mathematics, teachers will use a bilingual approach to teaching and learning, using both vernacular and English to develop students' understanding of the learning outcomes.

Lower Primary uses a bilingual approach as there are academic benefits for students being bilingual. Students continue to learn in their first language because learning only in English as a second language can limit their learning and social development. As students become confident in thinking, reasoning, problem solving and decision making in their vernacular, they are more able to learn another language such as English. Both inside and outside of the classroom, it is important to continue to develop, expand and enhance vernacular language to that used by adults.

Bridging to English

Bridging to English is the gradual change from vernacular to English instruction during Grades 3 to 5. Bridging, while maintaining vernacular language, helps students retain their identity, culture, self-confidence and self-esteem.

Bridging to English approaches are explained in the section titled Teaching and Learning Strategies. Examples of how to apply these approaches appear in the section titled Units of Work.

Using vernacular language for continued learning and development while English is being learned, is an effective way for Papua New Guinean students to develop to their full potential.

Integration

When teachers use integrated and bilingual education approaches in their classrooms, they are encouraged to create a relaxed, enjoyable environment in which they use a variety of teaching and learning strategies to help students acquire relevant skills, knowledge and understanding.

Integrated learning of subjects and learning outcomes is more likely to provide a meaningful and natural learning environment for students, and subsequently improve the quality of their learning.

Many learning outcomes from different subjects naturally collect or cluster together, allowing a thematic programming approach to be adopted by teachers. The integration is not artificial and is often determined by annual calendars of events and community activities to make the learning more meaningful to students. Learning outcomes that do not integrate easily, will of course need to be programmed separately.

Nature of Mathematics

Mathematics is a creative activity that uses reasoning and generalisation to describe patterns and relationships. Understanding Mathematics can be personally satisfying and empowering. The basis of everyday life is increasingly mathematical and technological. For instance, making purchasing decisions, budgeting, or considering health plans, all require an understanding of mathematics. In this changing world, those who understand and can do mathematics, will have significantly enhanced opportunities and options for shaping their futures.

Links with other levels

Mathematics at Lower Primary level links with Cultural Mathematics at the Elementary level and Mathematics at Upper Primary.

Links between Elementary and Primary levels

School Level	Elementary	Lower Primary	Upper Primary
Learning Area	Mathematics	Mathematics	Mathematics
Subject	Cultural Mathematics	Mathematics	Mathematics

Links to other subjects

The Mathematics learning outcomes covered in the Lower Primary Syllabus and Teacher Guide can also be linked with other subjects. Links can be made by clustering outcomes that link naturally together through similar concepts or processes. Units of work can be planned for these outcomes so that they are taught and learned in an integrated way.

Key features

This section highlights important things about Mathematics.

The Lower Primary Mathematics Syllabus and Teacher Guide are based on three fundamental learning principles:

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

This Teacher Guide continuously refers to previous knowledge and skills. Teachers need to see Mathematics in contexts that are familiar and of interest to the students. This contextual approach requires students to participate in both problem-setting and problem-solving processes.

Students need to use concepts and skills from many areas of Mathematics to find solutions to problems in real life situations. This approach facilitates a student-based mode of learning.

Lower Primary Mathematics is required to serve the needs of children who have completed three years of community-based Elementary education in vernacular, and will be continuing on to do Upper Primary Mathematics. Students will be given opportunities to develop a better understanding of mathematical concepts, in a bilingual classroom environment where Mathematics is learnt using relevant context.

Assumptions

It is assumed that each Grade 3 student would:

- have completed three years of Elementary education and have a sound understanding of numbers and numerals, measurement and geometry as used in the community
- be a fluent reader and writer in their vernacular and have good oral communication skills
- have mastered basic number facts for addition and subtraction and be able to use standard number symbols up to 50
- be nine years old
- use vernacular for most of their learning in Grade 3, while gradually bridging to English by the end of Grade 5
- continue to Upper Primary at the end of Grade 5.

Strands

There are five strands used in the Lower Primary Mathematics Syllabus to organise the content. The strands are Number and Application, Measurement, Space and Shape, Chance and Data, and Patterns. The five strands are further organised into a number of substrands to describe specifically the development of key ideas.

In each strand, the content is described as learning outcomes. These outcomes identify the knowledge, skills and attitudes to be learnt in each Lower Primary grade.

The five strands for Mathematics are outlined below with brief explanations of what is to be covered in each strand.

Number and application

In this strand, students learn to use local counting systems in the students' own language in the early part of Grade 3, as well as learning the formal language used in Mathematics. The concept of the four operations (addition, subtraction, multiplication and division) is dealt with in a practical way. The other common forms of numbers such as fractions, decimals and percentage are used in everyday situations.

Measurement

This strand concentrates on measurement and how it is applied in everyday living. The concepts in this strand focus on ways of estimating and measuring using local measurements as well as standard measurements. Students estimate, measure, calculate, record and present their measurements in meaningful ways.

Space and shape

In this strand, students learn the concepts and the language required to discuss shapes, angles and directions. They learn about the features of two and three-dimensional shapes, the properties of angles and to give and follow directions to move from one location to another.

Chance and data

In this strand, students use information to predict or make guesses about events that will happen, may happen or can never happen. Students also learn to use sets, statistical information, graphs and tables in practical situations.

Patterns

This strand deals with number patterns and local art patterns such as those used in bilums and pottery. Students are introduced to simple number patterns and their representations and meanings, as they use numbers to write and form patterns.

Substrands

The substrands allow the knowledge, processes and skills to be specific and described as learning outcomes. The substrands in the five strands of the Lower Primary Mathematics Syllabus and Teacher Guide are outlined in the table below.

Strands and substrands for Lower Primary Mathematics

Strands	Grade 3	Grade 4	Grade 5
Number and Application	• number and place value • operations: add, subtract, multiply, divide • fractions and decimals	• number and place value • operations: add, subtract, multiply, divide • fractions and decimals	• number and place value • operations: add, subtract, multiply, divide • fractions and decimals
Measurement	• length • area • volume and capacity • weight • time	• length • area • volume and capacity • weight • time	• length • area • volume and capacity • weight • time
Space and Shape	• shapes • angles and directions	• shapes • angles and directions	• shapes • angles and directions
Chance and Data	• probability and sets • graphs and tables	• probability and sets • graphs and tables	• probability and sets • graphs and tables
Patterns	• patterns	• patterns	• patterns

Developing knowledge, skills and positive attitudes

The Lower Primary Mathematics Teacher Guide is designed to enable students to see Mathematics as an exciting, useful and creative learning area of study. Students acquire an appreciation for, and develop an understanding of mathematical ideas as they apply in their daily lives.

Learning outcomes

The outcomes for each of the strands and substrands in this Teacher Guide describe what the students know and can do as a result of the learning experiences. These learning outcomes are specific statements that identify the knowledge, skills, attitudes and values that all students should achieve or demonstrate. These statements are student-centred and written in terms that enable them to be demonstrated, assessed or measured.

Indicators

The indicators are examples of the kinds of things the students would be able to do, know and understand if they have achieved an outcome. These are examples that you can use to plan your weekly and daily lessons. You can develop other indicators depending on the needs of your students and the resources available within the school or the community.

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 on students' achievements in relation to the learning outcomes
- allow students' achievement of the outcomes to be described in consistent ways
- help teachers to monitor student learning
- help teachers plan their teaching programs.

The Mathematics Syllabus and Teacher Guide places Mathematics into practical and familiar settings so that students have the opportunity to explore and use mathematical concepts in real life situations.

Inclusive curriculum

The Lower Primary Mathematics Syllabus must offer equal opportunities to all participants. Class activities and methods of assessment must be targeted fairly at both female and male students. To meet the ideals of our National Constitution, teaching, learning and assessment methods must be unbiased. They should be designed to meet the needs of all students irrespective of their gender, ability, geographical location, cultural and socio-economic background or special needs.

The National Constitution states, 'Every one to be involved in our endeavours to achieve integral human development of the person for every person and to seek fulfilment through his or her contributions to the common good.' (PNG National Legislation; interim version 4, 1 March, 2000, p.2)

Flexibility and relevance

It is important to establish a daily routine for students. However, teachers are encouraged to be flexible with the times allocated to allow for spontaneous learning experiences.

Special projects, field trips, unplanned events such as births and deaths, and natural disasters such as volcanic eruptions or landslides often provide opportunities for integrated holistic learning, which should be encouraged. Teachers should encourage students to take part in local activities such as compensation and bride price payments, where a lot of counting and grouping, especially in vernacular is taking place. This would make learning activities interesting and relevant.

Teaching and learning strategies

This section outlines some strategies for teaching in an integrated way. It explains bridging to English approaches and some useful and interesting strategies that are relevant to other subjects.

The learning outcomes provide the framework for teachers to use in their daily, weekly, term and year plans. In their planning, teachers in Lower Primary schools will use the learning outcomes from the syllabuses and the Elaborations in this Teacher Guide, to identify specific knowledge, skills and attitudes that can be developed in each grade.

Continuous assessment of student learning against these outcomes will ensure a supportive classroom environment that will meet the students' individual learning needs.

Here is a discovery-learning motto to keep in mind when planning activities for students who are learning in two languages.

Discovery learning

We remember:

20% of what we hear

40% of what we see

80% of what we discover for ourselves.

Bridging to English approaches

Children begin school using their first language for learning and development while the English language is being acquired. As students move into Lower Primary, a bridging process to learning in English is developed. The Curriculum Development Division has recommended five approaches to bridging to English for teaching in bilingual classes in Papua New Guinea. Each of these five approaches has been modelled in the units of work included in this Teacher Guide. They are the approaches to use when you are programming units of work. The five approaches are explained below.

1. Integrated programming and thematic approach

Teachers are encouraged to use an integrated programming and thematic approach in Lower Primary. First, you identify clusters of outcomes from within a subject or across several subjects, which link naturally together. Then, you identify a theme that links the outcomes. This helps to make learning activities interesting, relevant and appropriate for the students. Themes may be used for programming a unit of work to be taught for one to two weeks or longer.

2. Whole language approach

Within the integrated, thematic approach, the whole language approach will guide planning and teaching of the vernacular and English programs.

Teachers must create a rich environment with models of a variety of oral and written text types in the classroom. This helps students learn how whole texts are constructed. Many student-centred activities can also be created from whole texts for students to learn about the parts of language, such as letter–sound relationships, pronunciation, spelling, grammar and vocabulary.

3. Program separately for vernacular and English

Language development in vernacular and English needs to be planned separately for each subject. Students use vernacular for example, when they are learning difficult new content and content that is related to their own community lives, or for small group discussions. Students are introduced to English words and language features while they are learning the concepts in vernacular. Gradually, as students' vocabulary and understanding of English grows, they will learn more and more in English. In Grade 5 seventy percent of teaching, learning and assessment will be in English.

4. Use big books for both languages

Big books should be used as a main resource for both vernacular and English language development. Big books are usually used to introduce a new topic, new ideas, a new text type, new grammar and new vocabulary. Big books can be either fiction or information texts. You can make bilingual big books showing the same information or telling the same story in both vernacular and English.

5. Variety of genres

There will be a focus on different text types, or genres, associated with different language functions or purposes. These genres help students to understand how language can be used in powerful and interesting ways for different purposes. For example, we tell, read and write narratives to share experiences for enjoyment. We use procedures to explain how to make something or do something. We use reports to present factual information and explanations to explain why certain things happen. Arguments are used to present different points of view in powerful, persuasive ways. The following genres will be taught and practised in different subjects in Lower Primary:

• narrative
• recount
• procedure
• report
• explanation
• exposition.

You will be planning for the students to learn these different genres when you plan your units of work. Read the Lower Primary Language Teacher Guide for more information.

A sample of bridging to English in Mathematics

Strand: Number and application

Substrand: Fractions and decimals

Fractions with fruit

Type of activity	A simple group activity dealing with fifths and tenths
How and when to use	Suitable for use any time when teaching fractions
English words and expressions to teach	Halves, quarters, fifths, tenths, whole, equal pieces
Bridging strategies	Vernacular oral activity Group work station — English and vernacular
Materials needed	Pawpaw, coconut, pineapple, oranges and knives for each group Pictures for station cards at the back of each book

This activity uses fruit cut into fifths and tenths. The understanding of fractions as parts of a whole, and a tenth as half of a fifth is developed. Choose any readily available fruit. The fruit can be eaten at the end of the lesson if proper care has been taken to keep it clean. This also provides an opportunity to talk about good hygiene and health.

Before starting this activity, students must wash their hands and make sure they have a clean place on which to work, for example, a fresh banana leaf or a clean plate. When they have finished with the fruit they can share it with their group members.

In groups, students cut each fifth into two equal pieces. For each fruit, how many same size pieces are there altogether? What will we call each of these small pieces? In English each piece is called one tenth.

Put two one tenths together. What fraction does this make?
$^1/_{10} + ^1/_{10} = ^2/_{10} = ^1/_5$

In groups find out how many pieces of one tenth make two fifths?
$^1/_{10} + ^1/_{10} + ^1/_{10} + ^1/_{10} = ^4/_{10} = ^2/_5$

Follow up activities:

Activity 1: Choose a number. Count that many items. Show one fifth of that number.

Activity 2: Choose a number that is a multiple of 10. Count out that many items. Show one tenth of the number.

Using new words

You will use both vernacular and English as the main languages of instruction for Lower Primary. These will help facilitate understanding and reinforce meaning. Each substrand will have a list of new words; these have been included in the glossary of this Teachers Guide. You must refer to the glossary, or a dictionary, whenever you come across new or unfamiliar words.

The first few times students meet these key words, you should:

- say the word with the class a number of times
- write the word on the board, a chart, or on cardboard
- explain the meaning of the word using real objects, actions, pictures and examples
- demonstrate how to use the word in a simple mathematical sentence
- ask the students to use the words in simple mathematical statements
- tell the students to enter the word in their language vocabulary book or class dictionary.

Student-centred learning

The teaching approaches required for Mathematics are student-centred. They promote the philosophy of *how to think* not *what to think*. The student-centred learning activities include investigating, problem solving and out-of-class excursions. The students assume more responsibility for their own learning in this style of learning environment. The teacher becomes a facilitator and provides support and guidance for the students' learning. The students do more talking, and take part in many different activities that relate to real life experiences to develop critical thinking and understanding.

Students work cooperatively to discuss, make decisions, plan, organise, carry out activities, record results and report findings. Students also listen to each other's opinions, demonstrate their ideas and critically analyse results. Teaching and learning promotes the philosophy of 'known to known; 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 where possible student directed.

Thematic teaching and integration

Some teaching strategies in Lower Primary Mathematics 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. Content from other subjects provides suitable contexts in which to teach mathematics. For example, if students are studying traditional skills to produce arts from different provinces in Papua New Guinea, this would tie in with Patterns in Mathematics.

A thematic, activity-based approach is recommended in Lower Primary classes. Teaching and learning activities should be based on community themes as much as possible, derived from the community calendar and be sensitive to local culture, traditions and seasons. The development of skills should be emphasised.

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

Multigrade teaching

Usually teachers in a school would have one grade to teach for the whole year. In some communities enrolments are low, so schools may have multigrade classes. This means that two or three grades are grouped together and supervised by one teacher. The classes are made up of students of different ages, abilities, interests and needs.

It is important for multigrade classes to remain together for at least two, but usually three years. Where this occurs, an integrated approach using themes is recommended. The class teacher should select themes that will bring together different topics from the different subject areas in Lower Primary, such as Health, Environmental Studies and Community Living. Language and Mathematics should be taught in context within these same themes. The multigrade environment will allow faster mathematics learners to move on to more advanced concepts, while the slower ones can try to master the skills they have not yet picked up.

Mathematics teaching and learning strategies

Experience-based learning

Mathematical ideas are more likely to be remembered and used if they are based on students' experiences. In this approach, Mathematics is a "doing word". This idea can be expanded by having students use three steps in practical lessons:

- predict
- observe
- explain.

As an example of this strategy, when developing knowledge of fractions, a teacher might ask a class to predict where half way across the blackboard is. Students would then be invited to make a chalk mark where they think the half way mark is and write their initials next to the mark. When enough students have made their predictions while other students observed, the teacher asks, "How would we work out who is the closest?" Students then explain how to determine half of the way across the board and then carry out the measurements to confirm the results. Students could then practise this in pairs, estimating the half way mark on other objects.

Problem-based learning

Using this strategy, the teacher can set a problem or a task for the class to solve. For example, 46 is the answer I have from multiplying certain numbers. How did I get the answer?

Steps

- Brainstorm students' ideas and record them on the board.
- Ask related questions such as, "How many different multiplication strategies can you find?"
- Have students carry out the investigation in groups and report back to the class.

To make the learning explicit, it is important that the teacher creates a summary of what has been learnt from solving the problem.

Open-ended questions

Closed questions, commonly used in Mathematics lessons, only have one answer. Open-ended questions can have more than one answer and the variety of possible answers allows students to make important discoveries.

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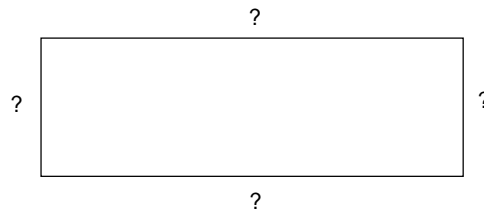
An example of an open-ended question is: 'The total perimeter of the rectangle above is 160 cm. Opposite sides are equal in length. What would be the lengths of the sides of the rectangle? How many different answers can you find?'

One answer could be 50 cm x 2 + 30 cm x 2. If a student comes up with one answer and stops, ask the class if anyone had a different answer. How many different answers are possible? You may allow the students to discuss their answers in groups and agree on an answer for presentation and discussion.

One open-ended question can provide many answers for students to find and provides them with practice basic skills. You may try out more open-ended questions with your students encourage a variety of ways to come up with answers.

Group work

The purpose of group work is to give students opportunities to share ideas and at the same time learn from other group members. Every group should have a leader to supervise the group's activities. The leader would, for example, delegate tasks and consult the teacher for assistance. Group activities can take place inside or outside the classroom. A good example of a group activity would be drawing shapes such as squares and rectangles, and making models of common three-dimensional shapes such as cubes or cones. Groups of students could also use a soccer field on which to measure distance and perimeter using traditional methods of measuring such as with strings and sticks.

Peer teaching and learning

This is organised as a partnership activity in which one student performs a task while the other observes and assists; making corrections and suggesting new ideas and changes. For example, one student decides to multiply three-digit numbers by two-digit numbers. The student who is observing should assist and make sure that all the steps are followed before the final answer is given. The teacher's role in this strategy is to observe and encourage positive interaction and effective communication through which the intended outcome can be achieved.

Projects

Lower Primary Mathematics projects allow students to use a wide range of mathematical concepts in practical contexts. Students can physically demonstrate their understanding of the learning outcomes, in various activities in which they have chosen to participate. For example, students could collect and use traditional materials to make informal measurements, or draw to scale simple maps of the school, village or community.

Mathematics games

There are a lot of Mathematics games students can play as part of their learning. One of these is a game known as *Fifteen*. The game is played by four students using 4 sets of 16 cards (or 64 cards numbered from 0–15).

The Game is called *Fifteen*

To make this game you will need cartridge paper, markers, scissors, rulers and pencils. The game is prepared by following the steps below.

1. Divide cartridge paper by drawing up small rectangles, 10cm by 4cm.

2. Cut out all the small rectangles.

3. Make 4 sets of 16 cards.

4. Number cards for each set from 0–15.

Note: There should be 64 cards altogether.

There are 4 players in each team. Each player has to hold on to one (1) set of cards numbered 0–15.

This is how the game is played:

- 4 players sit in a circle

- each player takes a turn to put down a card

- each player needs to watch carefully to see what number is placed in front of each player

- the person in the group who calls out *Fifteen* first whenever he or she sees any set of numbers that add up to 15, wins all the cards that are put down in front of them

- the winner of the game is the player with the most cards.

Below is a plan of how to draw up cartridge paper number cards to cut out.

Template to make number cards

0	1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	0	1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15	0	1	2	3	4	5
6	7	8	9	10	11	12	13	14	15	0	1	2	3
4	5	6	7	8	9	10	11	12	13	14	15	0	1
2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	0	1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15	0	1	2	3	4	5
6	7	8	9	10	11	12	13	14	15				

Teachers are encouraged to try out some of these strategies when teaching Mathematics at Lower Primary.

Assessment and reporting

Assessment

Assessment is the ongoing process of identifying, gathering and interpreting information about students' achievement of learning outcomes. In Lower Primary, assessment also needs to take account of the bilingual nature of teaching and learning. All assessment must link to the learning outcomes.

Teachers need to apply processes for assessment, recording and reporting that enable them to determine which learning outcomes students have achieved, and to report these achievements to parents in ways that make sense to them. The processes teachers use to assess, record and report students' achievements need to be manageable. Schools may decide to plan together on a whole school basis to share good assessment practice and to develop manageable assessment and reporting systems.

Students need to receive meaningful feedback about their achievement of learning outcomes. This can best be done using continuous assessment. The students' knowledge and skills are continually developing in a healthy classroom environment. It is important for teachers to be aware of, and record what the students know, can do, and understand. When this information is known about the students in the class, programming can be made more purposeful. It can be directed at learning weaknesses and made appropriate to the students' needs.

Criterion-referenced assessment

The approach to assessment that best aligns with an outcomes-based approach is criterion-referenced assessment.

Criterion-referenced assessment uses specific assessment criteria derived from the learning outcomes to judge a student's individual performance. It does not compare the performance of one student with that of another. This means that all students can demonstrate learning against individual criteria and all can find success against one or more criteria.

Unlike norm-referenced assessment, it is not used to rank students. It is used to determine what each student has learnt from the learning outcomes, in terms of knowledge, skills and attitudes. All of the assessment methods described below use this approach.

Teachers will need to be able to:

- identify valid and reliable assessment tasks from the learning activities
- develop specific assessment criteria that describe exactly what a student must do to be successful in the assessment task
- make sure the students are aware of and understand the assessment criteria
- give students feedback on their performance in each assessment task against the assessment criteria.

In this way students are very clear about what they must know, do and understand. They are given constructive feedback from the teacher on what they are doing well and what they need to do to improve. Teachers are very clear about what they are assessing and are able to apply fair, consistent assessment to all students' work.

Assessment and recording methods

The syllabuses outline the main assessment methods. This section will expand on these methods by providing:

- examples of the kinds of activities where that assessment method may be appropriate
- examples of how to record students' demonstration of the knowledge, skills and attitudes in the learning outcomes.

Observation

Teachers can gather much information about students' learning by observing them in both formal and informal situations inside and outside the classroom. Observation is used largely for assessing skills and so is best suited to assessing skills-based activities. It can also be used to assess students' knowledge and attitudes when they are expressed orally.

Examples of when to use observation to assess students' learning

Formal assessment tasks that use observation as the assessment method might include:

- oral presentations
- role-plays, dramatisations, dance or musical performances
- group work
- practical activities.

Informal observations can occur while students are working on normal learning activities both inside and outside the classroom. It is useful to inform students that you are assessing them and to make sure they know the assessment criteria that you want them to demonstrate. In this way more students are likely to be successful.

Students can also observe and give constructive feedback on each other's performances using the same assessment criteria. This is called peer assessment.

Ways of recording observations

There are a number of manageable ways to record observations of students' achievements. These include:

- checklists with comments
- class grids that allow the teacher to date their observations, and focus on a few students at a time each lesson until they have recorded information about all students. These grids can be used to repeat the observations a number of times to build a fuller picture of each students' learning

- having a page for each student in an exercise book to keep dated, anecdotal records of significant learning
- having students complete peer assessments that show the performance of other students, either as individuals or in groups, against the assessment criteria.

Sometimes it may be necessary for the teacher to talk to the student about what they are observing as it is possible to misinterpret information. For example, a student staring out the window during a writing activity may be seen to be wasting time. When questioned, the student may well respond with a comment such as, 'I was thinking what to write next,' or, 'I was translating my sentence from vernacular to English in my head first.'

Conferencing or talking to students

In similar ways, teachers can gather information about students' understanding of what they are learning by sitting and talking with students while they are working.

Examples of when to use conferencing to assess students' learning

This is most useful:

- in practical lessons where students are applying skills
- in language activities like shared or individual reading or when assessing students' writing
- in small group work
- in learning activities that are happening out in the community.

Teachers can ask relevant questions such as:

- What do you think is happening here?
- Why did you do it that way?
- Is there another way you could do this?

The purpose of conferencing is to gather information about students' knowledge and understanding of what they are learning. It can also give a good insight into students' attitudes to learning.

Ways of recording conference notes

The type of information gathered in conferences can be recorded on class grids or in exercise books with a page for each student.

Analysing students' products

This is probably one of the most common forms of assessment. The teacher sets an assessment task for students, explains the assessment criteria to them and then collects the students' products to see how well they have met the criteria.

Examples of when to analyse products to assess students' learning

Examples of work students produce might include:

- essays or written work
- models
- drawings, maps and diagrams
- art and craft samples
- community surveys and projects.

Teachers will need to make sure that the assessment criteria match the knowledge, skills and attitudes outlined in the learning outcomes being assessed. They will then have to decide how well the students have met these criteria. Teachers can use different scales to show various levels of achievement. For example, you could use scales like the ones below.

Examples of scales to show how well students performed on assessment tasks

Example 1	Example 2	Example 3
F. Student fully demonstrated the criteria	3. Student met the criteria most of the time	3. Student met the criteria independently
P. Student partly demonstrated the criteria	2. Student met the criteria some of the time	2. Student met the criteria with some assistance
NMP. Student needs more practice	1. Student did not meet the criteria	1. Student needs more practice

In Example 1, teachers would record an F for those students who fully demonstrated the criteria, a P for those who partly demonstrated the criteria and NMP for those students who need more practice.

Examples 2 and 3 use numbers as codes to show how well the students met the assessment criteria. Teachers can choose which codes are the easiest for them to understand and use. Examples of how these codes can be used for recording are in the section Units of Work.

Ways of recording information gained from analysing students' products

Teachers may keep written products, or records of students' achievements on particular assessment tasks, in student portfolios.

Tests

Examples of when to use tests to assess students' learning

Tests are used mainly to assess students' knowledge and understanding of subject content. Tests should be used for both formative and summative assessment, so that results can be used to help students improve in areas where they are having difficulty. In Lower Primary, tests are just one form of assessment and should be used in conjunction with the other assessment methods. This balanced approach to assessment gives students a greater chance of being successful as they are able to demonstrate their learning in different ways.

Ways of recording test results

Teachers normally record results of tests in record books. This can be done if the marks mean something and relate to the outcomes. For example, if a test was out of 10, then students who received marks:

- between 8 and 10 have demonstrated a good understanding of the outcome being assessed
- between 5 and 7 have demonstrated partial understanding of the outcome being assessed
- of 4 or less, need more practice or further instruction.

Teachers can also store students' tests with teacher comments in students' portfolios.

What to do with assessment information

Once teachers have gathered information from a number of assessment tasks they should be in a position to make decisions about which outcomes students have achieved.

Teachers need to look at all the evidence they have gathered about each student and decide if they have enough evidence to say that the student has achieved the outcome. Normally, to make this decision, teachers must be sure that the student has demonstrated the outcome independently and on a number of occasions; sometimes informally and sometimes in assessment tasks. Teachers can then record which students have achieved which outcomes.

One way of recording this would be to have a chart showing all of the outcomes by subject for the relevant grade. A sample of what this might look like appears on the next page.

Teachers could have one copy of the table for each student and colour the grid as each outcome is achieved. Teachers could lightly or partly colour the outcome box for students who are still working towards achieving the outcome. Whilst this is mainly for teacher's records, a chart such as this could be incorporated into a formal report. However, it would need further explanation for parents and guardians to understand the learning that has taken place.

Achievement of the learning outcomes

School:		Year:		Term:
Student:				Grade:

▓ A fully shaded box indicates the student has achieved that outcome for that subject.

░ A lightly or partly shaded box indicates the student is working towards that outcome.

Subject	Learning outcomes													
Arts	3.1.1	3.1.2	3.1.3	3.2.1	3.2.2	3.2.3	3.3.1	3.3.2	3.3.3	3.4.1	3.4.2	3.4.3	3.5.1	3.5.2	3.5.3
Community Living	3.1.1	3.1.2	3.1.3	3.1.4	3.2.1	3.3.1								
Environmental Studies	3.1.1	3.1.2	3.1.3	3.2.1	3.2.2									
Health	3.1.1	3.1.2	3.1.3	3.1.4	3.1.5	3.2.1	3.2.2							
Language	3.1.1 V	3.1.2 V	3.1.3 V	3.1.4 V	3.2.1 V	3.2.2 V	3.2.3 V	3.2.4 V	3.3.1 V	3.3.2 V	3.3.3 V	3.3.4 V		
	3.1.1 E	3.1.2 E	3.1.3 E	3.1.4 E	3.2.1 E	3.2.2 E	3.2.3 E	3.2.4 E	3.3.1 E	3.3.2 E	3.3.3 E	3.3.4 E		
Mathematics	3.1.1	3.1.2	3.1.3	3.1.4	3.2.1	3.2.2	3.2.3	3.2.4	3.2.5	3.3.1	3.3.2	3.4.1	3.4.2	3.5.1
Physical Education	3.1.1													

Assessment in vernacular and English

Bilingual education is used in Lower Primary where students learn in both their vernacular and English. They gradually 'bridge' from vernacular to English over the three years from Grade 3 to Grade 5. Teachers use both vernacular and English as the languages of instruction and so it follows that assessment should also be conducted in both languages.

Teachers will need to make informed decisions about which language should be used to assess the students. In some cases it may be appropriate to give the students a choice about the language in which they would like to be assessed. The exception to this is where you are actually teaching English to students. This of course will need to be assessed in English.

The table below provides a guide as to the percentage of assessment that should be conducted in each language.

Suggested percentage of assessment in vernacular and/or English

Grade	Vernacular	English
3	60%	40%
4	50%	50%
5	30%	70%

Examples of assessment and recording methods

Below are some examples of assessment and recording methods that you may like to use when assessing your students' performance in Mathematics.

Annotated class list

In this method, you can have a class list on which your students' learning can be recorded. It is a good idea to use this class list only for the things you did not expect the student to do. For example, a student who does not usually answer questions might suddenly respond well to questioning. This should be recorded on the class list. You must make entries in the checklist progressively and consistently. In this way, evidence is gathered to show how students have demonstrated achievement of the outcomes.

An example of an annotated class list is shown below.

Names of students	Comments on unexpected events
Zinnia	confusing with common fractions
Rosalind	having difficulty with subtraction of three-digit numbers
Norman	understood facts from 4 times tables well
Zazzmin	understood addition of three digits well

Profiles

You may set a series of mini-projects or exercises and keep samples of work from each student in their own individual folder. Student exercise books fulfill this function to some extent. Examination of students' exercise books can give a good indication of their level of understanding, especially if the work in their books is their own. (i.e. not copied from the board)

Another method of maintaining students profiles, is to only retain the best and latest version of a student's work. For instance, a student may not have demonstrated an ability to carry out long division in March, but in June is able to do so. With this method only the work produced in June will be kept, as it demonstrates that particular outcome has been achieved.

Conferencing or talking with students

To find out more about your students you should use good questioning techniques in class and in informal discussions with individual students. Relevant points from such talks must be noted; down for example, whether or not the correct mathematical terms were used to answer a question, and whether or not the student showed understanding of a concept. You can also be aware of what the students are doing and saying. Formal interviews may also provide information. A table like the one on the next page can help you record information gathered when talking to students.

Sample recording sheet for conferencing or talking with students

Names of students	Conference records on fractions			
	Use of maths terms	**Answers questions**	**Understanding of concepts**	**Other**
Zinnia	used the term denominator correctly	answered $^2/_3 + {}^1/_3$ correctly		
Rosalind	had difficulty trying to work out the term denominator	had difficulty working out $^1/_5 + {}^1/_3$ correctly	needs extra help to find the lowest common denominator	
Norman				

Observing students during lessons

You should make informal observations and record them 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. Record the date of each observation. In that way, you can see your students' progress.

Sample record sheet for observing students during lessons

Names of students	Positive things done during the lesson	Areas for improvement
Rosalind	*3rd August* answered $^1/_2 + {}^1/_2 = 1$ without calculating the answer	
Norman		*5th August* did not respond to $^1/_3 + {}^2/_3$ needs extra help *9th August* can now add fractions with the same denominator
Zinnia	*9th August* has a good understanding of common fractions	

Assessment tasks

These assessment tasks are applicable at the Lower Primary level.

Visual presentation

- posters
- drawings
- flow charts
- diagrams
- maps
- tables
- graphs
- labels

Writing

- writing symbols correctly
- setting out of work
- explanation
- assignments
- projects
- definitions
- simple formulae
- use of rules

Procedures

- comparing
- putting forward possible solutions
- ordering
- estimating
- presenting information
- inferring
- performing basic operations
- critical thinking

Attitudes

- respect
- caring
- cooperation
- acceptance
- perseverance
- appreciation of subjects
- enjoyment of subject

How can students show what they have learnt?

Keeping records of practical work

- models
- work samples
- class and group projects

Process

- identifying
- classifying
- investigating
- recognising
- predicting
- questioning
- drawing conclusions
- taking measurements
- observing
- interpreting

Oral tasks

- asking questions
- answering questions
- explaining
- describing
- relaying information
- practical concepts

Practical tasks

- models
- displays
- outside activities
- excursions
- practical activities
- solving problems
- drawing
- measuring
- applying knowledge and skills

Assessment tasks

These assessment tasks are applicable at the Lower Primary level.

Assessment tasks	Examples	Sample activities
Writing	writing symbols correctly	*Writing symbols correctly* (i) + = add or plus (ii) − = subtract or take away (iii) > = greater than (iv) < = less than
Keeping a record of practical work	class and group projects	*Class and group projects* Display in central place for everyone to see and then store in student portfolio
Visual representation	graphs	*Graphs* Draw a simple bar graph to show information collected from the community
Practical tasks	excursions	*Excursions* Visit an appropriate location. Draw and label all the different shapes they see in the environment
Procedures	estimating	*Estimating* Estimate, and later measure, distances in play areas, using both formal and informal measurements, and report the findings to the teacher and the class
Process	investigating	*Investigating* Investigate the formulae to work out the perimeter of a rectangular shape e.g. P = 2 sides + 2 sides
Research	small group research	*Small group research* Small groups record the different types of buildings found in the community and present their findings on a bar graph
Oral tasks	explaining	*Explaining* Students explain the process they used for their research activity
Attitudes	enjoyment of subject	*Appreciation* Enjoy Mathematics and appreciate that it deals with everyday mathematical problems facing them. They use their own language and resources to work on mathematical problems.

Class record sheet for observing students during lessons

Make up a sheet like this to keep an ongoing record of your students' marks.

Use a code to explain the marks:

- 5 indicates that the student met the criteria satisfactorily
- 4 indicates that the student met the criteria most of the time
- 3 indicates that the student met the criteria some of the time
- 2 indicates that the student rarely met the criteria
- 1 indicates that the student needs further practice to meet the criteria

Date	Name of student	Use of maths terms	Answers questions	Understanding of concepts	Uses correct symbols	Total
	Max. Marks	5	5	5	5	20
18/5/04	Zinnia	4/5	3/5	3/5	4/5	14/20
18/5/04	Rosalind	3/5	3/5	3/5	4/5	13/20
18/5/04	Norman	4/5	4/5	5/5	5/5	18/20
18/5/04	Elly	2/5	3/5	2/5	3/5	10/20

Reporting

When the time comes for formal reporting through written reports or interviews, teachers can look at all the evidence of students' learning in student portfolios and in their own records. They can then decide which outcomes individual students have achieved and report this information clearly to parents. Teachers should highlight what students have done well and how they can further improve. The National Assessment and Reporting Policy outlines what is required in formal school reports.

Students, parents and guardians are entitled to receive feedback about students' progress towards achieving the intended outcomes. This information must be clear, accurate and fair so that all concerned can take part in helping the student to improve their standard of achievement. Schools will decide the method of reporting that best suits the needs of the community. Methods of reporting may include:

- report cards
- record cards
- certificate of recognition designed by the school
- letters
- interviews
- teacher, student and parent conferences
- awards or tokens of appreciation.

Evaluation

Assessment information can also be used by teachers to evaluate the effectiveness of their teaching. By analysing class results as a whole, teachers can identify subjects, strands, substrands and outcomes where the students have done well and those that require further or improved teaching.

Similarly, a whole school can analyse results by subjects, strands and substrands, or by grades, and identify areas of strength and areas which need further attention. For example, if a whole school is not performing well in Mathematics, then Mathematics could become the focus for inservice and resource development for the next year. In this way assessment information serves two purposes:

- to improve students' learning
- to improve the quality of teaching.

Programming

A program is a detailed plan developed by teachers to manage teaching and learning activities for their students throughout the year. The main purpose of programming is to help teachers arrange the content of the course by developing a year plan and weekly programs.

A year plan, broken into terms, should show when all of the learning outcomes for each subject will be taught. Because an integrated approach to programming is recommended, learning outcomes that link naturally together should be put into clusters and described through themes that show the linking concept.

The year plan should also sequence individual subject learning outcomes that need to be taught on their own. The themes and individual outcomes for each term are broken down on a week-by-week basis for the four school terms.

Weekly programs detail teaching, learning and assessment activities for each week.

Samples of both types of programs appear below and in the Units of Work section of this Teacher Guide.

Developing a program

Characteristics of a good program

An effective outcomes-based program:

- maintains a focus on learning outcomes, showing what students must know and do to achieve the outcomes
- uses time flexibly, so that students with different needs can develop understanding and demonstrate specific outcomes over a period of time
- uses a variety of teaching and learning strategies. Teachers act as facilitators of learning and cater for different learning styles and individual needs of students
- emphasises the development of knowledge, skills and attitudes that promote lifelong learning
- provides opportunities for students to become effective, self-directed learners
- enables students to learn in a range of contexts
- supports learning through the use of a variety of texts, media and real-life materials and resources
- shows the links between the outcomes, teaching and learning activities and assessment tasks.

When programming, teachers should also take into consideration the following:

- providing a balance of activities including projects, practical work and assignments
- students' needs and interests
- the community calendar
- unplanned events
- holidays
- major school activities.

Mathematics programs

Syllabus considerations

The Mathematics Syllabus is structured in a way that allows for flexibility when planning the term or yearly program. The program you develop should cater for the needs of individual students, the school and the community. It is essential that Mathematics programs do the following:

- build on knowledge, skills and attitudes, issues and general understanding of all strands
- promote Mathematics processes and inquiry techniques to prepare students to become active participants in their society.

Some options for developing Mathematics programs include:

- teaching one of the sample units of work from a particular strand
- using the sample units of work as a guide to develop your own units of work relevant to local contexts
- using the sample units of work as a guide to develop integrated units of work which contain outcomes from other subjects.

Sample break down of strands, substrands and outcomes

Lower Primary Mathematics gives priority to an integrated and thematic approach to teaching and learning. However, for you to plan and program your teaching and learning activities and assessment tasks effectively, a sample break down of strands, substrands and outcomes for a term and for the year, are provided on the next page. You may use them during your planning and programming of your teaching and learning activities and assessment tasks for your class.

The sample below is quite different to the way most teachers draw up their overview, which is to complete a strand, followed by the next one, according to its level of difficulty. The sample below has one substrand spread across the four terms. This is to allow continuous teaching of the strand over the four terms. You may draw an overview that best suits you and your students.

Sample yearly overview of strands and substrands for Grade 3

Weeks	Term 1	Term 2	Term 3	Term 4
1	Number and place value	Number and place value	Number and place value	Operations (+ − x ÷)
2	Operations (+ − x ÷)	Operations (+ − x ÷)	Fractions	Fractions
3	Fractions	Decimals	Decimals	Length
4	Length	Length	Area	Area
5	Area	Volume and capacity	Volume and capacity	Volume and capacity
6	Weight	Weight	Weight	Time
7	Time	Time	Shapes	Shapes
8	Angles and directions	Angles and directions	Angles and directions	Probability and sets
9	Probability and sets	Probability and sets	Graphs and tables	Graphs and tables
10	Graphs and tables	Patterns	Patterns	Patterns

Sample term overview of strands and substrands for Grade 4

Weeks	Term 1	Term 2	Term 3	Term 4
1	Number and place value	Number and place value	Number and place value	Operations (+ − x ÷)
2	Operations (+ − x ÷)	Operations (+ − x ÷)	Fractions	Fractions
3	Fractions	Decimals	Decimals	Length
4	Length	Length	Area	Area
5	Area	Volume and capacity	Volume and capacity	Volume and capacity
6	Weight	Weight	Weight	Time
7	Time	Time	Shapes	Shapes
8	Angles and directions	Angles and directions	Angles and directions	Probability and sets
9	Probability and sets	Probability and sets	Graphs and tables	Graphs and tables
10	Graphs and tables	Patterns	Patterns	Patterns

Sample term overview of strands and substrands for Grade 5

Weeks	Term 1	Term 2	Term 3	Term 4
1	Number and place value	Number and place value	Number and place value	Operations (+ − x ÷)
2	Operations (+ − x ÷)	Operations (+ − x ÷)	Fractions	Fractions
3	Fractions	Decimals	Decimals	Length
4	Length	Length	Area	Area
5	Area	Volume and capacity	Volume and capacity	Volume and capacity
6	Weight	Weight	Weight	Time
7	Time	Time	Shapes	Shapes
8	Angles and directions	Angles and directions	Angles and directions	Probability and sets
9	Probability and sets	Probability and sets	Graphs and tables	Graphs and tables
10	Graphs and tables	Patterns	Patterns	Patterns

Sample overview of strands, substrands and outcomes

Teachers need to break up the outcomes to plan their teaching and learning activities each year. Drawing up an outcomes chart will give you a clear overview of the teaching and learning areas you will cover each term, so that all the outcomes for the year are taught. Below is a sample of an overview of learning outcomes for Grade 3. You may use the idea to draw up a similar overview for your class and the school.

Sample yearly overview of strands, substrands and outcomes for Grade 3

Strand	Substrand	Outcomes	Term	Week
Number and application	Number and place value	3.1.1 Count, order, read and represent two and three-digit numbers		
	Operations (+ − x ÷)	3.1.2 Use the four operations to do calculations with two and three-digit numbers		
	Fractions	3.1.3 Identify and recognise common fractions		
	Decimals	3.1.4 Identify decimal notation in real life		
Measurement	Length	3.3.1 Estimate and measure lengths, distances and perimeter using formal and informal units		
	Area	3.2.1.Estimate and measure area informal regular units		
	Volume and capacity	3.2.3 Estimate and measure volume and capacity using informal units		
	Weight	3.2.4 Estimate weight of objects using informal units		
	Time	3.2.5 Recognise formal and informal units of time		
Space and shape	Shapes	3.3.1 Identify two and three-dimensional shapes		
	Angles and directions	3.3.2 Recognise and compare angles		
Chance and data	Probability and sets	3.4.1 Use the language of chance to describe events		
	Graphs and tables	3.4.2 Draw and interpret simple graphs		
Patterns	Patterns	3.5.1 Make and describe patterns including number patterns		

Teachers are encouraged to use the sample from the previous page to draw up similar outcomes overviews for Grades 4 and 5.

Yearly and term programming using themes

Yearly and term programming is done by clustering outcomes that link naturally together. Themes are chosen for each cluster. Choosing the themes involves brainstorming. This process requires you to think about broad concepts that can be used to cover more than one subject area. The themes may come from community activities, events and ceremonies, seasons, or activities such as gardening, hunting and fishing. They can also come from outside events such as Independence Day, sports, Environment Day or Easter.

The diagram below shows examples of suggested themes for Grade 3.

Health

Arts

Environmental Studies

Events	Pollution
School holidays	The river
Our neighbours	Communication
Helping	My family
Trading	Transport
My country	Food

Mathematics

Physical Education

Community Living

Language
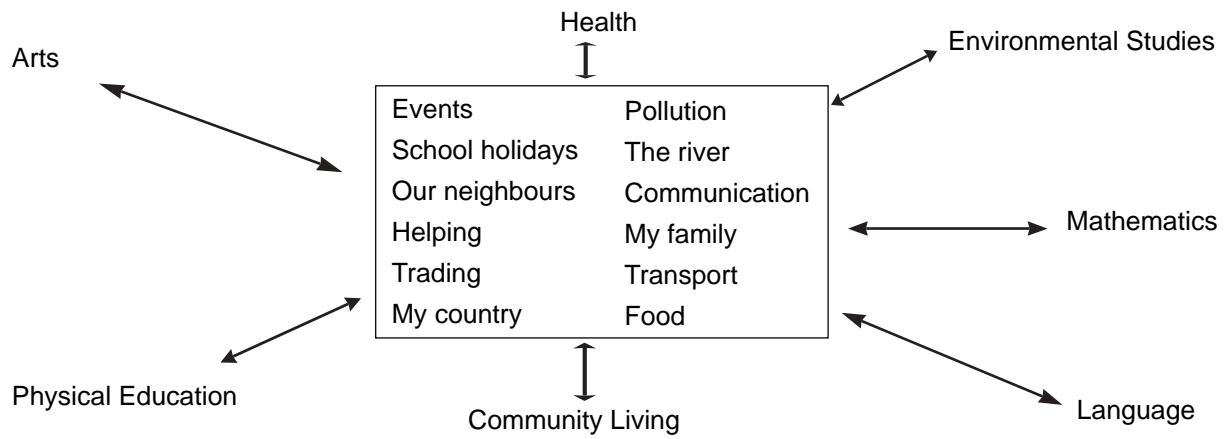
Working out the yearly overview using themes

The yearly overview is worked out by arranging the themes into a four term program for your grade. The table below shows an example of a Grade 3 yearly overview of the themes. You may use this sample to draw up your own yearly program. Outcomes not included in themes need to be added as stand-alone outcomes on this overview.

Sample yearly overview of themes for Grade 3

Week	Term 1	Term 2	Term 3	Term 4	Comments
1	My school	My family	Communication	National Education Week	
2	My environment	Provincial government	Helping others		
3		Population			
4			National Book Week	Population	
5	My country	Transport			
6			Events		
7	Our neighbours' world	Environment Day		Food	
8		Helping others			
9			Independence Day	Holidays	
10	Trading				

Units of work

A unit of work is a set of sequenced teaching and learning activities with assessment tasks, designed to help students achieve selected learning outcomes within a specific time frame.

Process for developing units of work

The following ten step process will guide teachers in their planning and developing of units of work. Some teachers may start at different steps in the process (or, for example, reverse the order of Steps 2 and 3) but eventually all steps will be covered. When the unit is completed, you should reflect on its success and make improvements if you plan to use it with another group of students in the following year.

1. ***Study the learning outcomes***

    Look at the learning outcomes for the seven Lower Primary subjects if planning an integrated unit of work.

    Look at the learning outcomes from one subject only if planning a unit of work for one subject.

2. ***Cluster learning outcomes***

    Cluster a small group of learning outcomes (about four) from across the subjects that link naturally together.

3. ***Identify a theme***

    Identify a theme to describe the natural links between the cluster of learning outcomes.

4. ***State the purpose of the unit of work***

    Summarise in two or three sentences what students will learn during this unit of work. Refer to the learning outcomes.

5. ***Identify the knowledge, skills and attitudes***

    Use the indicators from the syllabuses and the elaborations from the teacher guide, to identify the knowledge, skills and attitudes for the cluster of learning outcomes.

6. ***Develop teaching and learning activities and assessment tasks***

    Develop relevant teaching and learning activities and assessment tasks that help students to learn and demonstrate the knowledge, skills and attitudes.

    Develop teaching and learning activities for the Language learning outcomes in the unit of work, which incorporate bridging approaches.

7. ***State the language of instruction for teaching and learning activities and assessment tasks***

    Identify which language will be used for all of the teaching and learning activities and assessment tasks.

8. ***Estimate the time***

    Identify how many weeks it will take to teach the unit of work (probably no more than three weeks for Lower Primary students).

9. ***Develop a weekly teaching program***

    Use your own programming format to develop a weekly program.

10. ***Identify relevant resources and materials***

    List the resources and materials needed to teach the unit of work.

Sample units

Components of a unit of work

Each unit of work that you create should contain these components:

- grade
- strands and substrands
- learning outcomes
- links with other subjects
- theme
- teaching and learning activities
- assessment methods and tasks
- resources and equipment if required
- time frame.

Considerations when planning a unit of work

When planning a unit of work, the following should be considered:

- limit the number of outcomes selected as the focus for the unit of work to three or four to keep it manageable
- decide which of the Mathematics outcomes link naturally with other subjects
- clearly identify the content of the unit of work in terms of knowledge, skills and attitudes derived from the learning outcomes
- plan the assessment tasks while you are planning the unit of work
- where possible use up-to-date references and resources
- take account of the learning needs of your students
- address gender issues and cultural norms by making sure that the unit of work is inclusive and fair for all students.

Planning a unit of work from outcomes

As Primary school teachers, you have to manage all the outcomes for the seven subjects. Therefore you will need to work out ways of making your teaching and learning manageable. One way of doing this is to cluster outcomes that link naturally together. Then plan integrated units of work that allow you to teach several outcomes within a set period of time. Some ways in which you could cluster your outcomes are:

- using outcomes from within one strand in Mathematics
- using outcomes from across several strands in Mathematics
- using outcomes from across several subjects within one grade
- using outcomes from across several grades if you are teaching a multigrade class.

An example of an integrated unit of work, using outcomes from across several subjects within a grade, is provided in this section. You may use the process described above and the sample format given below as a guide when developing your own units of work. You can adapt the process and sample format to suit your needs or the needs of your students.

Sample unit of work

Below is a sample of an integrated unit of work for Grade 3 involving Mathematics, Environmental Studies, Community Living and Language.

Subject learning outcomes

Subject	Strand	Learning outcomes
Mathematics	Chance and data	**3.4.2** Draw and interpret simple graphs
Environmental Studies	What is in my environment	**3.1.1** Identify different species of plants and animals found in the environment
Community Living	Community	**3.1.1** Explain changes in the community and family life and the effects on people
Language	Writing	**3.3.1** Plan and produce a range of text types to develop familiar ideas and information

Theme: Making graphs of living things in my community

Purpose

In this unit of work students will use graphing skills and information relating to animal and plant species and people. They will construct and interpret graphs in vernacular and English.

Knowledge, skills and attitudes

Subject	Knowledge	Skills	Attitudes
Environmental Studies	• different types of plants and animals • where animals and plants are found	• collect, display and sort plants and animals into groups	• value their environment • self-confidence • cooperation • sharing • value
Community Living	• making charts showing daily activities • identify individuals belonging to different groups	• draw, name and show charts of daily activities • identify and group individuals	• pride • respect
Language	• vocabulary used for different graphs V/E • structure of simple sentences and questions	• make sentences about graphs • complete sentences about graphs • ask questions about graphs • spell and define key words	• self-confidence • pride • value
Mathematics	• picture graphs • simple graphs using concrete materials • read picture graphs	• make picture graphs • collect data and show information using graphs • draw and read information	• value • self-confidence • pride • respect

Teaching and learning activities and assessment tasks

Mathematics

- draw and interpret picture graphs where one picture represents a number of objects
- collect and show information on simple graphs using concrete materials
- collect and show information using tallies
- draw simple graphs and read information from them
- students present their graphs and ask and answer questions

Environmental Studies

- research and collect data on different species of plants and animals
- explain, describe, sort and analyse varieties of plants and animals
- show their findings on a graph
- excursions to places such as the beach; share their experiences
- list names of plants and animals in vernacular and English
- conduct a survey of animals and plants in the village
- draw a bar graph showing different types of animals in the village

Community Living

- share points of view about changes in the community
- find out about and report on the history of the community
- use role-play to show the importance of family members and their contribution to the family and other groups
- make murals to show the groups that individuals belong to, such as class, family or sporting groups
- survey a number of people in the village
- draw a table to show the number of people in the village

Language

- write information about nearby communities and show information in graphs
- use visuals such as graphs to enhance the meaning of their writing
- collect data on different species of plants and animals and write a big book
- define, draw and explain different graphs
- write a descriptive text about a plant or an animal found in the local environment

Assessment plan

Theme: Making graphs of living things in the community

Outcomes: Mathematics: 3.4.2, Environmental Studies: 3.1.1,
Language: 3.3.1 and Community Living 3.1.1

Learning outcomes	Assessment tasks	Language V/E	Assessment criteria	Assessment methods	Recording methods
Environmental Studies 3.1.1	• draw a bar graph showing different plants and animals in the community	E	• draw bar graph with numbers 1– 20 on the left side • names of animals at the bottom • shade in the number of animals found in the village	• analysing students' bar graphs	• student work sample with teacher's comments (place in a file)
Mathematics 3.4.2 and Community Living 3.1.1	• draw a table to show the number of people in the village	E	• table must have 4 columns and 2 rows • columns should be labelled sex, adults, students and infants • rows should have male and female on the left side • fill the table with correct information	• analyse students' tables	• students' work with teacher's comments (in portfolios)
Language 3.3.1	• write a descriptive text about a plant or an animal from the local environment	V	• uses paragraphs to describe features of selected plant or animal • uses descriptive language • correct spelling	• analyse students' writing	• use scale to show how well students met the assessment criteria

Time frame for unit of work

This unit of work is integrated across four subjects and will take two weeks to complete.

Sample weekly program

Time	Monday	Tuesday	Wednesday	Thursday	Friday	No.	Subject	Mins per Lesson	Total
8.00 to 8.15	**A s s e m b l y (15 mins)**					1	Assembly	5 x 15	75
8.15 to 9.00	Language 105 mins	Mathematics 45 mins	Mathematics 45 mins	Mathematics 45 mins	Language 105 mins	2	Mathematics	3 x 45 1 x 30	165
9.00 to 9.30		Block Time 30 mins	Block Time 30 mins	Block Time 30 mins		3	Language	2 x 105 3 x 90 1 x 60 1 x 30	570
9.30 to 10.00		Physical Education 30 mins	Arts 30 mins	Physical Education 30 mins		4	Health	3 x 30	90
10.00 to 10.30	**R e c e s s**					5	Environmental Studies	4 x 30 1 x 60	180
10.30 to 11.00	Health 30 mins	Language 90 mins	Language 90 mins	Language 90 mins	Language 30 mins	6	Community Living	1 x 60 3 x 30	150
11.00 to 11.30	Language 60 mins				Arts 30 mins	7	Physical Education	2 x 30 1 x 60	120
11.30 to 12.00					Mathematics 30 mins	8	Arts	3 x 30 1 x 60	150
12.00 – 1.00	**L u n c h**					9	Religious Education	2 x 30	60
1.00 to 1.30	Environmental Studies 60 mins	Environmental Studies 30 mins	Health 30 mins	Health 30 mins	Environmental Studies 30 mins	10	Block Time	3 x 30	90
1.30 to 2.00		Community Living 60 mins	Community Living 30 mins	Religious Education 30 mins	Community Living 30 mins	**Total Minutes**			**1650**
2.00 to 2.30	Religious Education 30 mins		Environmental Studies 30 mins	Arts 60 mins	Physical Education 60 mins				
2.30 to 3.00	Community Living 30 mins	Environmental Studies 30 mins	Arts 30 mins						

Relevant resource materials

For this unit of work to be taught effectively, the following recommended resources are needed for integration.

Materials Supplied		Materials to be made or collected	Materials to be borrowed
• Pupil's book • Grade 3 teacher resource book • A4 paper • Blank charts • Coloured pencils	• Markers • Grid paper • Cards and dice • Mathematics charts • Crayons • Plasticine	• Sticks and stones • Magazines and pictures • Newspapers • Big books • Cards and dice • Murals and models	• Big books • Shell books • Song books • Video tapes • Library books

E

Elaboration of learning outcomes

Elaborations describe the knowledge and skills included in each of the learning outcomes. They identify the content to be taught to the students. Elaborations are designed to help teachers understand the context of the outcomes. Teachers, using the elaborations, can develop teaching and learning activities that meet the needs of their students. For each learning outcome the elaborations describe:

• recommended knowledge

• recommended processes and skills

• and in some subjects, suggested activities.

Recommended knowledge

Knowledge is what students are expected to know and understand. The knowledge and concepts identified from the outcomes for Lower Primary Mathematics are listed as short statements under the heading Recommended Knowledge. The knowledge listed in the elaborations can be used by teachers to create units of work that are relevant to students' needs and the local context.

Recommended processes and skills

Skills are what students can do, and so the Recommended Processes and Skills section of the elaborations describes the skills that students need to demonstrate to achieve the outcomes.

Suggested activities

Some subjects provide a list of suggested teaching and learning activities for each outcome. Teachers can select those from the list that are relevant to the needs of their students. This list is not exhaustive so teachers can also develop their own teaching and learning activities relevant to the local context.

Strand: Number and application

Substrand	Grade 3	Grade 4	Grade 5
Number and place value	**3.1.1** Count, order, read and represent two and three-digit numbers	**4.1.1** Count, order, read and record three and four-digit numbers	**5.1.1** Order, read and write four and five-digit numbers
Recommended knowledge	• counting in 5s, 10s and 20s • counting backwards and forwards by 10s and 100s • use place value to show units, tens and hundreds • traditional and Arabic numbers • ordinal numbers • odd and even numbers • numbers to 1000 can be	counted using concrete materials • use place value to represent whole numbers including three and four-digit numbers • use place value to show tenths and hundredths • use words and symbols for less than <, more than >, equal to = and approximately equal to , to compare numbers ≈ • similarities and differences between numbers and sets of numbers	• square, cubed, prime, composite, triangular, odd and even numbers • numbers can be written in ascending and descending order • round off numbers to the nearest 1000, 10 000 • use place value to show tenths, hundredths and thousandths
Recommended processes and skills	• compare groups of numbers • count backwards and forwards • count by groups, and odd and even numbers • read and write numbers to 999 • represent place value of numbers using base ten materials • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies	• count numbers up to 1000 • read and write thousands, hundreds, tens and units in words and numerals • compare numbers • estimate numbers • use place value to show thousands, hundreds, tens, units, tenths and hundredths • arrange objects in patterns • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies	• read and write four and five-digit numbers in words and numerals • use base ten materials to represent numbers • arrange numbers in ascending and descending order • develop and apply number patterns and rules • round off numbers to the nearest tens, hundreds, thousands and tens of thousands • use place value to represent four and five-digit numbers, including decimals • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies

E

Strand: Number and application

Suggested activities	• use base ten materials and count and compare groups of 5, 10 and 20s • say and compare traditional number systems with arabic numbers • use ordinal numbers such as 1st, 2nd, 3rd, 4th, when ordering objects in real life situations such as running races • use place value to order numbers from the largest to the smallest and vice versa • identify some ways numbers are used in everyday life • give reasons for placing numbers in a particular order • recognise and explain number patterns such as odd and even numbers	• count numbers up to 1000 using concrete materials • compare numbers with words and symbols for more or less than, using concrete materials • order three and four-digit numbers • estimate numbers and count to confirm estimates • show thousands, hundreds, tens, units, tenths and hundredths in place value table • arrange objects in patterns such as two groups of three (2 x 3) to identify the number of objects used • identify some ways numbers are used in everyday life • make the largest and the smallest number from given three or four-digit numbers • solve a variety of problems using problem-solving strategies including trial and error, drawing diagrams, using tables, working backwards and looking for patterns • ask questions involving three and four-digit numbers	• represent numbers up to tens of thousands using base ten materials • arrange numbers in ascending and descending order • name and use composite, prime, triangular, square, cubed, odd and even numbers • round off numbers to the nearest tens, hundreds, thousands and tens of thousands • use place value to represent thousands, hundreds, tens, units, tenths, hundredths and thousandths • use four and five-digit numbers in real life situations such as dealing with population statistics and money • pose problems involving four and five-digit numbers • explain why the numbers 1, 4, 9, 16, ... are called square numbers

Strand: Numbers and application

Substrand	Grade 3	Grade 4	Grade 5
Operations (add, subtract, multiply, divide)	**3.1.2** Apply and use the four operations to do calculations with two and three-digit numbers	**4.1.2** Apply and use the four operations to do calculations with three and four-digit numbers	**5.1.2** Apply and use the four operations to do calculations with four and five-digit numbers
Recommended knowledge	• addition involves joining or putting together and subtraction involves taking away • addition is finding the total • subtraction is finding the difference • approximate answers are useful and accepted in certain situations • multiplication can be modelled by equal groupings and repeated addition • division can be modelled by equal groupings and repeated subtraction	• addition is finding the sum or total • subtraction is finding the difference • multiplication can be modelled by equal groupings and repeated addition • division can be modelled by equal groupings and repeated subtraction • recognise that division is the inverse operation to multiplication	• a range of mental strategies for addition, subtraction, multiplication and division involving two, three, four and five-digit numbers • recognise mathematical names given to answers obtained from the four operations i.e. *sum* for addition, *difference* for subtraction, *quotient* for division and *product* for multiplication • relationship between division and fractions ($^1/_2$ means 1 divided by 2)
Recommended processes and skills	• use concrete materials to add, subtract, multiply and divide • use the terms add, plus, is equal to, take away, minus, and the difference between, and write their symbols • use number sentences, numerals, concrete materials, symbols and pictures to record number • recall multiplication facts for 1, 2, 5 and 10 • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies	• add and subtract three and four-digit numbers with and without concrete materials • record methods used to add, subtract, multiply and divide • calculate multiplication and division facts • use short and long division signs • identify square numbers such as 1, 4, 9, 16, 25 • recall multiplication facts for 3, 4, 6 and 11 • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies	• add and subtract four and five-digit numbers with and without concrete materials • use mental strategies to add and subtract numbers and estimation to check solutions to problems • use different operation signs to indicate division • short and long multiplication • short and long division • recall multiplication facts for 7, 8, 9 and 12 • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies

E

Strand: Number and application

Suggested activities	• add and subtract in real life situations such as buying and selling at the market or trade store • make equal groupings and describe them using 'lots of' or 'groups of' e.g. 2 lots of 3, and 3 groups of 4 • model multiplication e.g. 3 groups of 2 is the same as 2 groups of 3 • model division as repeated subtraction • record addition, subtraction, multiplication and division problems using concrete materials, symbols, numerals and words • apply the four processes to solve problems in real life contexts • ask questions that can be solved using the four operations • use estimation to check solutions to real life problems such as giving and receiving change • explain how answers were obtained using the four operations	• add and subtract three and four-digit numbers, with and without trading, using concrete materials; record their methods • calculate multiplication and division facts using groups e.g. 3 groups of 4 is 12, and 12 shared among 3 is 4 • describe and record methods used in solving multiplication and division problems • list multiples of a given number such as 24 • calculate division problems with remainders • use inverse relationship of multiplication and division to check answers e.g. $63 \div 9$ is 7 because $7 \times 9 = 63$ • solve problems using number strategies including trial and error, drawing diagrams, working backwards and looking for patterns • reflect on a chosen method for finding a solution to a problem and consider whether it can be improved • apply the four processes to solve problems in real life contexts	• add and subtract four and five-digit numbers, with and without trading, using concrete materials • use estimation to check solutions to addition and subtraction problems e.g. $1438 + 129$ is about $1440 + 130$ • use formal written algorithms and apply place value concept to solve addition and subtraction problems • multiply four and five-digit numbers by one and two-digit numbers using extended form (long multiplication) • divide four and five-digit numbers by one and two-digit divisors • pose problems that can be solved using more than one operation • explain whether an exact or approximate answer is best suited to a situation; check solutions by using inverse operations or different methods • apply the four processes to solve problems in real life contexts

E

Strand: Number and application

Substrand	Grade 3	Grade 4	Grade 5
Fractions and decimals	**3.1.3** Identify and recognise common fractions	**4.1.3** Compare and represent common fractions	**5.1.3** Use the four operations to solve problems related to proper fractions
Recommended knowledge	• recognise a half, a third and a quarter as part of a whole object • fraction names: half, third and quarter • fraction notation: $^1/_2$, $^1/_3$ and $^1/_4$ • common fractions such as $^1/_2$, $^1/_3$, $^1/_4$, $^1/_5$, and $^1/_{10}$	• recognise fractions with denominators 2, 4, and 8 • fraction words such as mixed numbers, proper and improper fractions, and equivalent fractions • fraction parts: numerator and denominator • fraction notation: $^1/_2$, $^1/_3$ and $^1/_4$ • equivalent fractions • add and subtract fractions with the same denominator	• fraction words such as mixed numbers, proper and improper fractions, and equivalent fractions • fraction parts: numerator and denominator • fractions in operations e.g. $^1/_4$ of 24 • use of the four operations with fractions
Recommended processes and skills	• use fraction notation for half ($^1/_2$), third ($^1/_3$), and quarter ($^1/_4$) • use concrete materials to show halves, thirds, quarters, fifths and tenths • write symbols for and names of common fractions • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies	• represent common fractions using pictures, symbols and words • addition and subtraction of simple fractions with same denominator • compare simple equivalent fractions • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies	• use fraction words such as numerator, denominator, equivalent fractions, mixed numbers, proper and improper fractions • add and subtract common fractions • use the whole numbers first approach, to add and subtract simple mixed numbers • change mixed numbers into improper fractions, and improper fractions into mixed numbers • multiply simple fractions such as _ x _ = $^1/_8$ • divide fractions with same denominators • apply the five processes of questioning, reflecting, reasoning, communicating and applying strategies

E

Strand: Number and application

Suggested activities	• model a half, one third and one quarter of a whole, using real objects such as fruit • describe parts of an object or collection of objects as, about a half, more than a half or less than a half • match symbols of fractions on cards, with pictures and words • show halves, quarters and thirds of objects and groups using concrete materials e.g. $\frac{1}{2}$ of a pawpaw or $\frac{1}{4}$ of 20 stones • use knowledge of fractions in real life contexts such as sharing a pawpaw between four people	• model halves, quarters, and eighths of a whole or a collection of objects in different ways, using pictures, groups, symbols and words • place common fractions on a number line • in groups make fraction walls for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$ and $\frac{1}{10}$ • add and subtract fractions with same denominator e.g. $\frac{2}{3} - \frac{1}{3} = \frac{1}{3}$ • compare simple equivalent fractions e.g. $\frac{1}{3}$ and $\frac{4}{12}$, $\frac{1}{3}$ and $\frac{2}{6}$ • use knowledge of fractions in real life contexts	• model and represent fractions with denominators 5, 10 and 100 • add and subtract common fractions e.g. $\frac{1}{4} + \frac{1}{2} = \frac{1}{4} + \frac{2}{4} = \frac{3}{4}$ • divide simple fractions with same denominator e.g. $\frac{2}{3} \div \frac{1}{3} = \frac{2}{3} \times \frac{3}{1} = \frac{6}{3} = 2$ • multiply simple fractions e.g. $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$ • calculate simple fractions as decimals and percentages e.g. $\frac{1}{4} = 0.25 = 25\%$ • use knowledge of fractions in real life contexts

E

Strand: Number and application

Substrand	Grade 3	Grade 4	Grade 5
Fractions and decimals	**3.1.4** Identify decimal notation in real life situations	4.1.4 Compare and represent simple decimals up to two decimal places	5.1.4 Use the four operations to solve problems related to decimals
Recommended knowledge	• Papua New Guinea currency is kina and toea • coins are different from notes in appearance and value • kina and toea are separated by a decimal point • decimals in the four operations	• use of decimals in real life situations such as in money and measurement • decimals separate whole numbers from tenths • use decimals in the four operations up to two decimal places • decimals can be compared in the same way as whole numbers • decimals can be converted to fractions and percentages • rounding off decimals to the nearest whole number or tenth	• application of decimals in money and measurement • relationship between percentage, fraction and decimal • rounding off decimals to the nearest whole number, tenth or hundredth • use decimals in the four operations up to three decimal places • the symbol % means percent
Recommended processes and skills	• match coins and notes with names and symbols for amounts of money • count money • add, subtract, multiply and divide simple money problems, using the decimal point to separate kina from toea	• show tenths as decimals, as an extension of the concept of place value • add and subtract decimals with trading using concrete materials • multiply and divide decimals with trading using concrete materials • expess fractions as decimal numbers e.g. twenty five and six tenths is 25.6 • interpret decimal notation for tenths and hundredths • match simple fractions with decimals • express common percentages as fractions or decimals e.g. 5% means 5 out of 100 or 0.05	• represent whole numbers and decimals using concrete materials • order decimals from smallest to largest and vice versa using base ten materials • compare decimals and fractions • express common percentages as fractions or decimals e.g. 25% means 25 out of 100 or 0.25 • calculate simple percentages

E

Strand: Number and application

Suggested activities			
	• give out money in coins: 1t, 2t, 5t, 10t, 20t, 50t, K1.00 and notes: K2, K5, K10, K20 and K50	• discuss common everyday use of decimals such as in money and measurement	• compare decimal numbers and place them on a number line
	• discuss how kina and toea are separated by a decimal point e.g. K0.30, K1.50	• add and subtract decimals with trading, using concrete materials	• represent numbers involving hundreds, tens, units, tenths and hundredths, using concrete materials
	• add and subtract simple money problems such as K2.60 + K0.50 and K5 – K2.50	• multiply and divide decimals with trading, using concrete materials	• visit the trade store or market, record the prices of goods and round them off to the nearest kina
	• multiply and divide simple money problems such as K2.50 x 2 = K5.00 and K6.00 ÷ 3 = K2.00	• interpret decimal notation for tenths and hundredths e.g. 0.1 is the same as $^1/_{10}$	• record weight, volume and length of common objects, as whole numbers or decimals, by changing the units of measurement e.g. 475 g = 0.457 kg
	• set up a shop in the classroom and play games, giving and receiving correct change	• weigh certain quantities and record measurements in decimals	
	• visit the trade store and record the different ways in which prices of goods are written	• identify and match simple fractions with decimals e.g. $^1/_2$ = 0.5, $^1/_4$ = 0.25 and $^1/_{10}$ = 0.1	

E

Strand: Measurement

Substrand	Grade 3	Grade 4	Grade 5
Area	**3.2.2** Estimate and measure areas using informal regular units	**4.2.2** Estimate and measure areas of surfaces using standard units of area	**5.2.2** Use appropriate metric units to measure and calculate area
Recommended knowledge	• informal ways of measuring area • standard units to measure area are square centimetres and square metres	• standard units of area are square centimetres and square metres • cm^2 and m^2 as standard symbols for square centimetres and square metres	• standard units of area are square centimetres, square metres and hectares • cm^2, m^2 and ha as standard symbols for square centimetres, square metres and hectares • length x width (L x W) is the formula to calculate the area of a rectangle
Recommended processes and skills	• use appropriate informal units to measure area • compare the areas of similar shapes • estimate area in informal units	• use appropriate standard units to estimate and measure area • compare areas of objects • estimate area and check by measuring	• use standard units to measure area, such as square centimetres and square metres • use formula L x W to calculate areas of rectangles • estimate, measure and compare areas
Suggested activities	• use informal regular units to measure areas without gaps and overlaps • cover common surfaces with different objects, then describe the amount of surface in terms of the number of objects • estimate areas within the environment, using informal units such as squares of paper or leaves • make simple squares to use for measuring	• measure surfaces using paper cut to the size of a square centimetre and a square metre • compare areas of objects such as a desk top and cupboard by drawing area grids • estimate areas of sports fields and classrooms then check by measuring • develop the concept of using a formula (L x W) by marking out and counting the number of squares in the rows and columns, and expressing as 5 squares by 4 squares for example	• calculate simple areas using the formula L x W, and record them using the units square centimetres, square metres and hectares • measure and calculate areas of squares and rectangles using grids • estimate, measure and compare areas of triangles, formed by cutting rectangles diagonally • estimate then calculate the area of regular and irregular shapes

Strand: Measurement

Substrand	Grade 3	Grade 4	Grade 5
Volume and capacity	**3.2.3** Estimate and measure volume and capacity using informal units	**4.2.3** Estimate and measure volume and capacity using standard units	**5.2.3** Estimate, measure and solve problems using standard units of volume and capacity
Recommended knowledge	• informal ways of measuring volume and capacity	• standard units of volume such as cubic centimetre and cubic metre • cm^3 and m^3 as standard symbols for cubic centimetres and cubic metres • standard units of capacity are millilitre and litre • mL and L as standard symbols for millilitre and litre • basic relationships such as $1000\ cm^3 = 1\ m^3$ and $1000\ mL = 1\ L$	• standard units of volume such as cubic centimetre and cubic metre • cm^3 and m^3 as standard symbols for cubic centimetres and cubic metres • standard units of capacity such as millilitre and litre • mL and L as standard symbols for millilitre and litre • basic relationships such as $1000\ cm^3 = 1\ m^3$ and $1000\ mL = 1\ L$
Recommended processes and skills	• estimate and measure volume and capacity using informal units • identify when we use volume and capacity in everyday life	• estimate and measure volume using concrete materials • compare and order capacity of two or more containers • identify containers holding more or less than 1 Litre	• measure volume using standard units such as cm^3 and m^3 • convert m^3 to cm^3 • measure capacity using standard units such as 1 L, $1/2$ L, and $1/4$ L • convert L to mL
Suggested activities	• estimate volume and capacity of everyday objects using appropriate informal units • measure capacity of containers by counting the number of smaller containers it takes to fill the big container • identify some ways volume and capacity are used in everyday life • estimate and check volume and capacity using informal units such as boxes or cartons	• pack cubic units such as blocks into rectangular containers so there are no gaps • measure volume using common units such as cm^3 and m^3 • compare and order the capacity of two or more containers by filling them and recording how much water it takes to fill each one • measure capacity using common units such as 1 L, $1/2$ L, and $1/4$ L	• measure volume and capacity using common units such as cm^3, m^3, L and mL • add and subtract volume of objects using decimal notation • explain why the smaller the container the more that are needed to measure capacity e.g. more cups than ice cream containers are needed to fill a bucket

E

Strand: Measurement

Substrand	Grade 3	Grade 4	Grade 5
Weight	**3.2.4** Estimate weight of objects using informal units	**4.2.4** Estimate and measure weight of objects using standard units	**5.2.4** Estimate, measure and solve problems using standard units of weight
Recommended knowledge	• informal ways of measuring weight • comparison words: heavier, heaviest, lighter, lightest	• standard units of weight are grams and kilograms • g and kg as standard symbols for grams and kilograms • scales are the instruments used for weighing • basic relationships such as 1000 g = 1 kg	• standard units of weight are grams, kilograms and tonnes • recognise g, kg and t as standard symbols for grams, kilograms and tonnes • basic relationships such as 1000 g = 1 kg and 1000 kg = 1 t
Recommended processes and skills	• use comparison words such as heavier, heaviest, lighter and lightest in English, and compare them to their vernacular equivalents • discuss and explore the need for smaller and larger units of weight • identify when we use volume and capacity in everyday life	• compare weights using phrases like greater than and less than • use standard weights to weigh objects • read different kinds of scales, such as balance scales, kitchen and bathroom scales • identify common weights such as 1 kg, 5 kg, 10 kg, 20 kg and 25 kg	• compare and order weights from lightest to heaviest • convert grams to kilograms and vice versa • use standard weights to weigh objects • read different kinds of scales accurately
Suggested activities	• use common items, such as shells and stones of similar size and weight, to compare and weigh objects • collect, estimate and weigh common household goods • discuss and solve real life problems, such as weight of goods that can be carried by hand, and those that need to be pushed in a trolley	• classify weights by size and recognise equal weights • use standard weights such as 1 kg, 2 kg, 5 kg and 10 kg to weigh objects • weigh objects and write number sentences using the correct words and symbols • express weights as fractions and decimals 100 g = $\frac{1}{10}$ kg = 0.1 kg • use standard weights such as 1 g, 10 g, 20 g and 50 g to weigh light objects	• convert $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{5}$ and $\frac{1}{10}$ of a kilogram to gram equivalents • weigh, label and display real objects to match common weights such as 1 kg, 500 g, $\frac{1}{2}$ kg, 250 g, and 1$\frac{1}{4}$ kg • describe and compare weights of unknown items, such as the weight of the teacher, weights of children and the weight of a truckload of goods • calculate the cost of sending parcels of different weights through the post, using information booklets from the post office

Strand: Measurement

Substrand	Grade 3	Grade 4	Grade 5
Time	**3.2.5** Recognise formal and informal units of time	**4.2.5** Tell and read time accurately to the quarter hour	**5.2.5** Compare and discuss the relationship between units of time and tell time correctly
Recommended knowledge	• informal ways of measuring time • standard units of minutes and hours • words about time such as day, night, afternoon, morning, weeks, months, years, in Vernacular and English • 7 days = 1 week	• formal ways of measuring time • standard units of seconds, minutes and hours • words about time such as day, week, month, year, decade and century • quarter intervals of time using *past* and *to* • recognise hour, half hour and quarter hour • basic relationships of time such as: 60 seconds = 1 minute 60 minutes = 1hour 24 hours = 1 day 7 days = 1 week 365 days = 1 year 12 months = 1 year	• standard units of seconds, minutes and hours • five minute intervals of time using *past* and *to* • symbols for morning and afternoon (am, pm) and 24 hour time • basic relationships of time such as: 60 seconds = 1 minute 60 minutes = 1hour 24 hours = 1 day 7 days = 1 week 365 days = 1 year 12 months = 1 year 10 years = 1 decade 100 years = 1 century
Recommended processes and skills	• estimate short periods of time • sequence daily events in the local community • order units of time from shortest to longest and vice versa • read and interpret calendars and time lines	• estimate time • read digital and analogue clock faces to quarter hour intervals • recognise hour, half hour and quarter hour times • recall time facts such as 7 days = 1 week	• estimate time • read digital and analogue clock faces to five minute intervals • compare and order lengths of time • convert digital time to analogue time and vice versa • convert 12 hour and 24 hour clock times • read and interpret times-tables
Suggested activities	• discuss the timing of different daily activities • use time words such as days, weeks, months, years, seasons • explain the sequence of events in the local community	• draw and use clock faces to tell the time to the quarter hour • discuss the timing of activities in stories • relate school activity times to hour, half hour and quarter hour times	• tell time accurately to within 5 minutes using clock faces • read and interpret timetables that use the 24 hour clock, such as airline or shipping timetables

E

Strand: Space and shape

Substrand	Grade 3	Grade 4	Grade 5
Shapes	**3.3.1** Identify two and three-dimensional shapes	**4.3.1** Investigate and describe features of two and three-dimensional shapes	**5.3.1** Describe properties of two and three-dimensional shapes
Recommended knowledge	• recognise two-dimensional shapes such as squares, triangles and rectangles • recognise three-dimensional shapes such as cubes, cones, spheres • names of two and three-dimensional shapes • features of two and three-dimensional shapes • two and three-dimensional shapes can be combined to make new shapes • recognise and name two and three-dimensional shapes	• recognise number of edges and corners in two-dimensional shapes • recognise number of faces, edges, vertices and curved surfaces in three-dimensional shapes • recognise lines of symmetry • names of two and three-dimensional shapes	• properties of two and three-dimensional shapes • types of triangles such as scalene, isosceles, equilateral and right-angled • understand lines of symmetry • regular polygons
Recommended processes and skills	• identify and describe features of two and three-dimensional shapes such as corners, edges and faces • recognise common two-dimensional shapes such as squares, rectangles, circles and triangles • recognise common three-dimensional shapes such as cubes, spheres and cones	• use terms such as edges, faces, vertices and surfaces to describe features of three-dimensional shapes • recognise two shapes dimensional shapes such as squares, rectangles, circles, triangles and trapezoids • recognise three-dimensional shapes such as cubes, spheres, cones, pyramids and prisms	• describe the properties of two and three-dimensional shape using terms such as faces, corners, edges and curved surfaces • make nets of cuboids, triangular prisms and pyramids • identify lines of symmetry
Suggested activities	• make, then name and describe squares, triangles and rectangles in vernacular and English • collect different solids such as logs, timber, empty boxes, and talk about the number of edges, faces and corners • join two-dimensional shapes together to make new shapes, such as two triangles to give a square	• describe features of two and three-dimensional shapes such as faces, edges and curved surfaces • make models of solid shapes such as cuboids, cones and prisms using local materials • fold paper shapes to identify lines of symmetry • identify two and three-dimensional shapes from within their environment	• make nets of cuboids, triangular prisms and pyramids • describe the properties of triangles • name scalene, isosceles, equilateral and right-angled triangles • draw polygons such as pentagons and hexagons

Strand: Space and shape

Substrand	Grade 3	Grade 4	Grade 5
Angles and direction	**3.3.2** Recognise, compare and order angles	**4.3.2** Recognise, name and describe angles	**5.3.2** Construct and name angles
Recommended knowledge	• recognise angles such as $1/2$, $1/4$, $3/4$ and full turns • four main directions: north, south, east, west	• recognise angles such as $1/2$, $1/4$, $3/4$ and full turns • recognise and name angles such as acute, right, straight, obtuse and reflex • use of grids and coordinates	• names of angles such as acute, right, straight, obtuse, reflex and revolution • number of degrees represented by different angles • use of grids and coordinates to describe positions • measure angles in degrees
Recommended processes and skills	• take turns to give simple directions such as half, quarter and full turns • draw simple angles such as right angles and straight angles • name and use the four main directions: north, south, east, west	• describe different angles such as right acute, straight, obtuse and reflex angles • order and compare different angles • draw grids and coordinates to describe positions	• construct angles using protractors and angle testers • estimate and measure angles in degrees • use protractors to measure angles in degrees • locate positions on a grid given simple directions • give directions by moving to the east, west, north and south
Suggested activities	• recognise and compare different angles within the environment • name angles such as half, quarter and full turns in vernacular and English • use the clock face to make whole, half and quarter turns • play games in vernacular and English that involve giving and receiving directions e.g. *Simon says* • give directions using the four main directions: north, south, east, west	• identify, order, compare and name angles within their environment • describe different angles such as right, acute, straight, obtuse and reflex, and model them using concrete materials • make and use angle testers to compare corners with right angles and half right angles • draw grids and coordinates to describe positions • draw simple school maps using compass directions, N, S, E, W	• construct angles using protractors, angle testers and other concrete materials • explore and measure properties of angles • estimate and measure angles in degrees • draw and label angles such as acute, right, straight, obtuse, reflex and one revolution • give directions by moving to the east, west, north and south • locate positions on a grid given simple directions such as N, S, E, W

E

Strand: Chance and data

Substrand	Grade 3	Grade 4	Grade 5
Probability and sets	**3.4.1** Use the language of chance to describe everyday events	**4.4.1** Compare events according to their likelihood	**5.4.1** Perform and record results of trials
Recommended knowledge	• recognise language of chance: certain, uncertain, possible, impossible and likelihood • know certain and impossible things • Venn diagrams	• perform and record results of simple trials • use language of chance such as a fifty-fifty chance and a certainty • Venn diagrams	• perform and record results of trials using tallies • understand the terms joint and disjoint sets, null, universal and complimentary sets • recognise symbols for common sets such as ϕ for null sets U for universal sets
Recommended processes and skills	• use words like certain or uncertain, possible or impossible to describe the likelihood of an event • record information about sets using simple Venn diagrams	• draw tally tables to show results of trials • use language of chance in everyday contexts e.g. a fifty-fifty chance, or a one in two chance • record information about sets using Venn diagrams	• use sets to describe real life situations • use terms null, universal, disjoint and complementary sets • record information about sets using Venn diagrams
Suggested activities	• in English and Vernacular discuss the likelihood of rain falling or someone winning a race • play coin throwing (heads or tails) or throw a die and discuss the possibilities of throwing a head or tail 5 consecutive times • investigate family or community activities and discuss them as certain or uncertain events and report to the class • talk about sets and have students record certain and impossible events using disjoint sets	• play tossing or throwing games using coins, dice and matchboxes and record results • use Venn diagrams in simple situations, such as recording outcomes of coin tossing or a dice game • talk about real life situations such as shopping, sports and marketing, and record results on a Venn diagram	• play games such as lucky dip and record results • play games using cards, coins and dice and predict the likelihood of an event e.g. picking a queen from a pack of cards • obtain results from daily events such as weather and sports reports and record them • use sets to describe real life situations

Strand: Chance and data

Substrand	Grade 3	Grade 4	Grade 5
Graphs and tables	**3.4.2** Draw and interpret simple graphs	**4.4.2** Construct and interpret information using graphs and simple timetables	**5.4.2** Represent and interpret information using graphs, tables and charts
Recommended knowledge	• picture, bar and column graphs • graphs represent information • the use of tallies to represent information in tables	• bar and column graphs • recognise and interpret bar charts • recognise data presented in timetables, column graphs and picture graphs	• bar and column graph • use of scales to draw graphs • understand information presented in tables, graphs and charts • use of terms average, mean, mode and median
Recommended processes and skills	• collect information and show it using simple picture and bar graphs • record information using tallies • draw and interpret picture, bar and column graphs	• interpret information on simple schedules and timetables • use graphs to symbolise information gathered • draw and label bar graphs with title, axes and scale	• construct bar and column graphs to scale • find the mean, median and mode in sets of data
Suggested activities	• make graphs using children as symbols to show information, such as those wearing shoes, those wearing thongs and those with no footwear • collect information and show it on simple picture and bar graphs where one symbol represents one object • talk about methods of interviewing and how to record information using tallies	• in other subjects, gather information and present it as bar or column graphs • discuss and interpret information from timetables, such as Air Niugini timetable • use graphs, timetables and charts in real life situations	• explore different types of tabled information, such as airline schedules, postage and shipping tables • draw bar graphs to scale e.g. 1 cm = 5 people • find the average rainfalls, and average ages and weights of students • use available data, such as records of average rainfall to find the mean, median and mode

E

Strand: Patterns

Substrand	Grade 3	Grade 4	Grade 5
Patterns	**3.5.1** Make and describe patterns and number patterns	**4.5.1** Develop arithmetical rules to describe number patterns	**5.5.1** Use patterns and arithmetical rules to solve problems
Recommended knowledge	• recognise common patterns used in the community • develop an understanding of arranging objects in groups to form patterns	• recognise patterns formed by different objects • understand simple arithmetical rules to describe number patterns	• number patterns formed by triangular, square and cubed numbers • develop arithmetical rules to describe number patterns
Recommended processes and skills	• identify and model common patterns • identify and write simple number rules to describe patterns	• show number patterns using concrete materials and diagrams • write arithmetical rules to describe number patterns • make, write and describe number patterns from arithmetical codes	• use mental strategies to find rules for number patterns • solve problems about patterns
Suggested activities	• identify and model common patterns used in the community, such as, on bilums, mats, blinds and bamboo walls • stitch patterns and designs on clothes; horizontally and vertically • make patterns without leaving empty spaces e.g. using geometrical shapes such as pattern blocks • use beans, shells or stones to form triangular shapes and count the numbers used e.g. 1, 3, 6, 10	• demonstrate curved stitching using threads, cardboard and nails, to form different patterns • write arithmetical rules to describe number patterns such as 2 x (the last number) + 5 = …… • develop number patterns and find their rules e.g. 2, 4, 6 has the rule: + 2 to the last number	• identify and make number patterns using triangular, square and cubed numbers • make, write and describe number patterns from arithmetical codes • solve problems about patterns and functions e.g. how many triangles there are in a hexagon

Resources

Resources recommended in this Teacher Guide are listed in three parts:

- documents issued by the National Department of Education (NDOE)
- community resources
- materials published by other organisations and commercial companies.

The Mathematics Lower Primary Syllabus and this Teacher Guide recommend many different materials. This is due to the fact that students learn best when they use real or concrete materials. Many of the materials that you need for Mathematics can be collected by you and your students. Before students use new materials they need to explore them. This will help them to concentrate on the tasks that you set, instead of wanting to play with the new materials. However, it is also important to note that progressively, the students should move away from concrete materials and work directly with symbols.

NDOE documents

Resource books

These are some text books you may want to borrow from friends, other schools, high schools, teachers' colleges or even buy for your own use. You are encouraged to find them to support your planning, programming and teaching. Most of these books are listed under the reference section of the Mathematics Syllabus.

NDOE (2003) *Upper Primary Mathematics Syllabus,* NDOE, Waigani

NDOE (2003) *Worked Examples for Upper Primary Mathematics Outcomes,* NDOE, Waigani

NDOE (2003) *Grade 6 Mathematics Student Books 6A and 6B,* Oxford, South Melbourne

NDOE (2003) *Grade 6 Mathematics Teachers' Guide,* Oxford, South Melbourne

NDOE (2002) *Inservice units to support the Implementation of the Lower Primary Curriculum Reform,* NDOE, Waigani

NDOE (2001) *Grade 5 Mathematics Teachers' Guide,* Oxford, South Melbourne

NDOE (2001) *Grade 5 Mathematics Student Books 5A and 5B,* Oxford, South Melbourne

NDOE (1999) *Grade 4 Mathematics Student Book 4A and 4B,* Oxford, South Melbourne

NDOE (1999) *Grade 4 Mathematics Teachers' Resource Book,* Oxford, South Melbourne

NDOE (1997) *Community School Mathematics 3B,* Oxford, South Melbourne

NDOE (1997) *Community School Mathematics 2A and 2B*, Oxford, South Melbourne

NDOE (1997) *Community School Mathematics 3A*, Oxford, South Melbourne

NDOE (1995) *Secondary School Mathematics 7A and 7B,* Longman, South Melbourne

NDOE (1995) *Secondary School Mathematics 8A and 8B,* Longman, South Melbourne

NDOE (1992) *Community School Mathematics Pupils' Books 6A and 6B,* NDOE, Waigani

NDOE (1992) *Community School Mathematics Teachers' Guide 6A and 6B,* NDOE, Waigani

Community resources

Human resources

Apart from the materials and resources that are listed, you will have many human resources in your communities. Such people could be carpenters, aid post orderlies, nurses, retired teachers, councillors, village leaders, local level government workers, workers from non-government organisations, church pastors, academics on holiday, business people and many others.

They will be more than willing to asist you if you ask them politely. You are strongly encouraged to make use of these people whenever possible.

Collection of objects

In most of the lessons, your students will need objects for counting, estimation and measuring. These can be small stones, buttons, shells, bottle tops, seeds, beads or similar items. These objects can be easily collected from the students' environment. You should encourage the students to collect them at the beginning of the school year and store them in small containers or boxes.

The table below shows some of the materials and resources that you and your students will need during lessons. The National Department of Education supplies some of these materials, while others can be purchsed from shops near you.

Materials that can be used across the three Lower Primary Grades

Materials	Materials supplied	Materials to be made or collected	Materials to be borrowed
	Grades 3, 4 & 5	**Grades 3, 4 & 5**	**Grades 3, 4 & 5**
	• linking cubes • pattern blocks • Lower Primary Mathematics Kit • Grades 3, 4 and 5 Pupils' Books from Oxford • Grades 3, 4 and 5 Teacher's Resource Books • Mathematics Lower Primary Syllabus and Teacher Guide • Mathematics Upper Primary Syllabus and Teacher Guide • Worked Examples for Upper Primary Mathematics Outcomes.	• containers of different sizes, dice, balances, square metre • fraction boards, clock face • 2-D shapes such as squares, rectangles, circles • 3-D shapes, such as cubes, cylinders, prisms, pyramids • 2-D and 3-D nets • angle chart, cardboard spinner • objects of different sizes • 12 and 24 hour clocks • tessellation patterns • plumb lines • newspapers and magazines	• measuring cylinders and beakers • weights such as 1 kg, 2 kg, 5 kg, 10 kg, 20 kg • weighing scales • containers of different sizes such as jugs, cups, spoons, bucket or pots • thermometers • calculators • Melanesian School Mathematics Dictionaries

Other

Sinebare Musawe (1994) *Melanesian School Mathematics Dictionary,* Dellasta, Victoria

de Klerk-Cougar, 1986 *Illustrated Mathematics Dictionary for Schools in Papua New Guinea,* Longman, Melbourne, Australia

Materials and equipment that can be made or purchased

While the Department of Education supplies some of the above materials, not all schools will have these materials readily available. It is recommended that schools can either buy them from local stores, or make them. Some instructions are provided for those who wish to make these materials themselves.

Small number cards

You will need many cards for writing numbers, fractions and decimals. When you write on these cards, make sure that you take care of them properly. Students copy examples. If you are careless, they will also be careless. Always store the number cards in their correct place.

You will need firm cardboard.

- Cut the cardboard into 4 cm x 4 cm squares. Make as many squares as you can (at least 150).
- Number the cards so that you have at least ten sets of cards numbered 0 to 9. Leave the remaining cards blank so you can write other numbers on them as you need them.

The cards should look like this:

1	2	3	4	5	6	7	8	9	10

Times table cards

You will need a set of cards for the times tables (2 times to 12 times). These should be no smaller than 3 cm x 8 cm. You can make these cards yourself with cardboard. Here are the steps to follow:

- Cut the cardboard into rectangles, at least 3 cm x 8 cm. You will need 13 cards for each times table. If you make a set for each of the times tables (2 times table to 12 times table), you will need 143 cards altogether.
- Write a times table fact on each card. Here are some examples for you to follow:

0 x 5	3cm	1 x 5	2 x 5	3 x 5

←—8cm—→

4 x 5	5 x 5	6 x 5	7 x 5

8 x 5	9 x 5	10 x 5	11 x 5	12 x 5
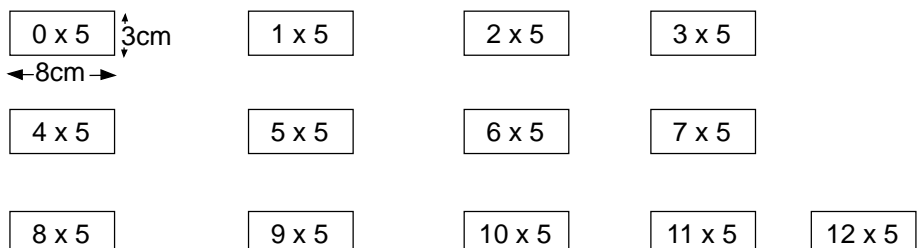
Division facts cards

You will need a set of cards for the division facts up to 100 divided by 10. These should be no smaller than 3 cm x 8 cm. You can make these cards yourself using cardboard. Follow the steps below:

- cut the cardboard into rectangles, at least 3 cm x 8 cm. You will need 11 cards for each set of division facts. If you make a set for each of the division tables (division by 2 to division by 10), you will need 99 cards altogether
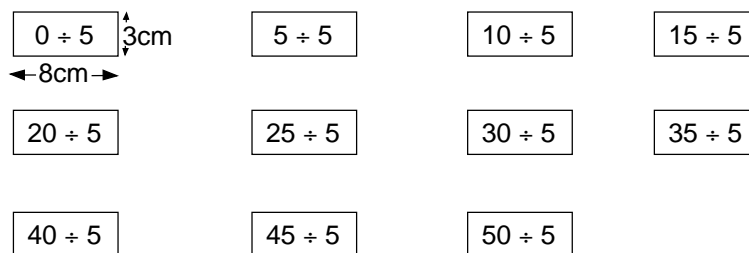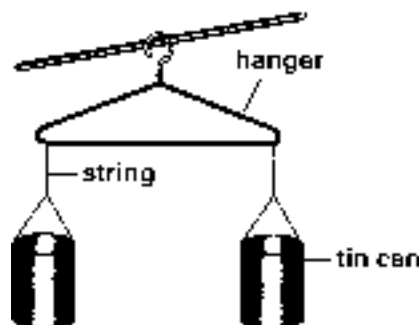- write a division fact on each card. Below are examples of the division by 5 facts.

| 0 ÷ 5 | 3cm | 5 ÷ 5 | 10 ÷ 5 | 15 ÷ 5 |
←8cm→

| 20 ÷ 5 | 25 ÷ 5 | 30 ÷ 5 | 35 ÷ 5 |

| 40 ÷ 5 | 45 ÷ 5 | 50 ÷ 5 |

Making balances

You can make a balance scale like the one below using a coat-hanger, 2 cans and string.

Coin rubbing

Plastic Papua New Guinea coins have been supplied to Lower Primary and they can also be purchased from school suppliers. If your school does not have them, you need to make some for your class. Here are the steps to follow to make coin rubbings.

You will need one of each type of coin, some paper and pencils:

- place a piece of paper over one side of the coin
- rub a pencil across the surface until the coin markings show on the paper
- cut around each coin
- to make the rubbings stronger, glue them on to cardboard of the same size
- make as many of each coin as you need
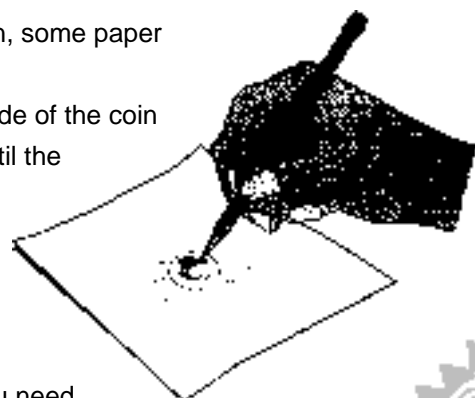
Angle testers

To make angle testers, you will need two thin strips of card about 15 centimetres long, a paper fastener or a drawing pin, and plasticine or a cork to put over the point:

• cut two strips of card as shown in the diagram

• make a hole near the end of each strip

• join them together by pushing a paper fastener through the holes. If you do not have a paper fastener, push a drawing pin or nail through the hole and place a piece of plasticine or cork over the sharp point

push paper fastener through here

Geoboards

You will need a piece of board, some small nails and a hammer:
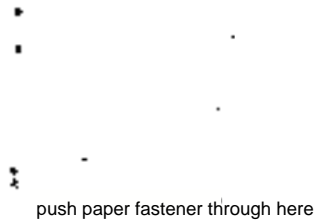
• cut the board into a square at least 16 cm x 16 cm. You will need one board for each geoboard that you may want to make

• rule a 2cm grid on the piece of board

• hammer nails into the intersecting points on the grid as shown here.
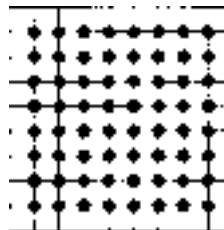
Fraction kits

You will need cardboard and rulers:

• cut five squares of card 8 cm x 8 cm

• leave some squares blank and rule lines on the others as shown in the diagram below

• cut the squares into pieces along the lines

• record 1 on the whole square. Record $\frac{1}{2}$ on each of the two pieces of the second square. Record $\frac{1}{4}$ on each of the four pieces that make a whole. Record $\frac{1}{8}$ on each of the eight pieces that make a whole.

8cm

8cm

Glossary

Explanations of terms used in this teacher guide are provided in two parts: subject specific and general.

Subject specific terms

bar graph	a diagram which uses narrow horizontal bands of varying lengths to show different amounts so that they can be compared
circles	sets of points which are a fixed distance from a known point called the centre
column graphs	a diagram which uses narrow vertical bands of varying lengths to show different amounts so that they can be compared
composite number	numbers larger than 1 and not a prime number
compound shapes	geometrical shapes or figures made up of more than one shape
cones	solids which have a base and come into a point at the top, similar to the shape of an ice-cream cone
cubed numbers	numbers obtained as a result of multiplying a real number by itself three times
data	a collection of facts, numbers or symbols
decimal system	a number system with a base of ten
denominator	the number on the bottom of a fraction
factors	numbers that divide into another number exactly; for example, 2, 3, 4 and 6 are factors of 12
graphs	drawings or diagrams which show the relationship between two variables
imperial system	the system of measurement where feet and inches are used rather than metres and centimetres, and gallons are used rather than litres
improper fraction	a fraction whose numerator is larger than its denominator
integers	any positive or negative whole number including zero
lowest common denominator	the smallest number that will divide evenly into the given denominators

lowest common multiple	the smallest multiple which is common to a set of given numbers
metric system	the decimal system of weights and measures
metric units	units of measurement used in the metric system
mixed number	a fraction which contains a mixture of both whole numbers and fractions
notation	a form of representing numbers by symbols
numerator	the number on the top of a fraction
prime numbers	numbers larger than 1, that are divisible only by 1 and the number itself
probability	the chance of a particular thing happening
proper fraction	a fraction whose denominator is larger than its numerator
pyramids	three-dimensional shapes which have a polygon for a base while other faces are triangular
quadrilaterals	plane shapes with four sides
quotient	the answer obtained in division
ratio	a comparison of two quantities by expressing one as fraction of the other
rational number	an integer or a fraction
scales	devices to measure weight
set	a group of things that have a shared quality
shapes	physical outlines of objects
square numbers	numbers obtained as a result of multiplying a real number by itself twice

General terms

accurate	to be exact, correct, right, or without error
assessment	assessment is the ongoing process of identifying, gathering and interpreting information about students' achievement of learning outcomes
assessment criteria	assessment criteria are statements that are used to judge the quality of a student's performance
assessment method	an assessment method is a particular way of assessing students

|	
assessment task	an assessment task is an activity specially designed to find out about a student's achievement of particular skills, processes and knowledge
balanced assessment	balanced assessment requires teachers to use a variety of assessment methods
contextual	connected with a particular context
derived	obtained from the original source; for example, cultural mathematics is derived from culture, which means the mathematics is based on the culture of the country
evaluation	gathering and interpreting data to make judgements about the effectiveness of teaching and learning programs, or assessment and reporting practices
explicit	clear and easy to understand
lingua franca	a shared language of communication used by people whose main languages are different
minimise	to reduce to the lowest possible level
multiculturalism	including people of different races, religion, languages and traditions
norm-referenced assessment	compares students' achievements with the achievements of others; the usual purpose being to rank students
portfolios	a recording method consisting of a folder used for storing samples of students' work
profiles	collections of students' work
recording	gathering accurate written evidence about students' learning, drawn from a range of contexts
reporting	presenting evidence of students' achievements of the learning outcomes

Appendices

Appendix 1

Suggested percentages of vernacular and English usage

Papua New Guinea's Language Policy in All Schools (NDOE, 1999) requires a bilingual approach to education that incorporates bridging to English in Grades 3, 4 and 5. The graph below gives you an indication of approximately how much time you will be teaching in vernacular and English in these grades.

Percentage of teaching, learning and assessment in vernacular and English
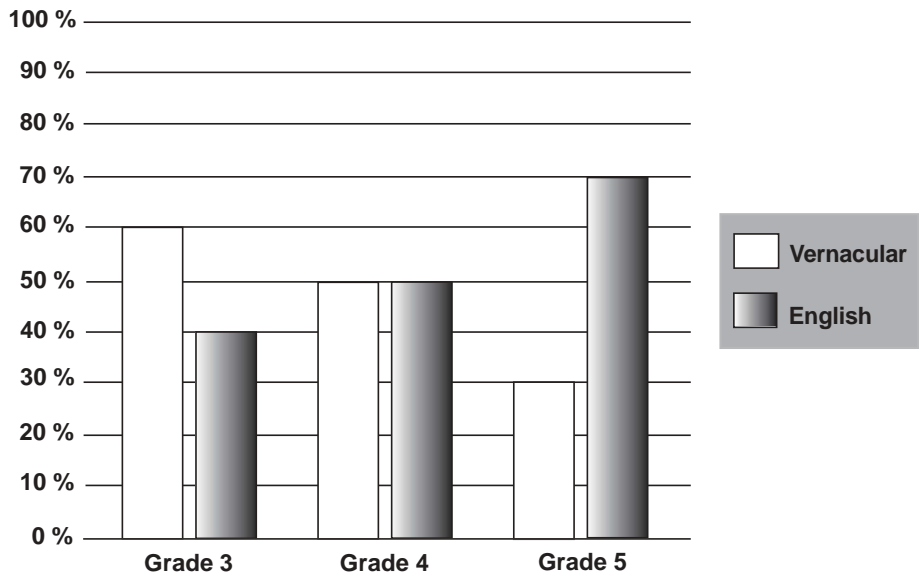
In the classroom this means that in Lower Primary Mathematics, as well as in all the other Lower Primary subjects, you will be planning teaching, learning and assessment activities for students in both vernacular and English. As the classroom teacher, you will be the best person to decide when it is appropriate to use vernacular to support the students' learning, and when it is appropriate to introduce the English terms and language features to the students. Language is the vehicle for learning, so it is very important that you help students to learn and understand the knowledge and skills from each subject in vernacular, while at the same time introducing them to the English words, phrases and language structures required of that subject. Grade 3 teachers will be introducing a lot of new English vocabulary and language features to students, while teaching mostly in vernacular. Grade 5 teachers will be using English as the main language of instruction in all subjects and using vernacular as a way of enhancing students' understanding of the concepts. In this way language will be used and taught explicitly in all subjects at Lower Primary.

Appendix 2

Weekly time allocations for Lower Primary subjects

The curriculum reform allows teachers increased flexibility. Lower Primary teachers developing units of work must make sure that the following weekly time allocations for each grade and subject are met by the end of each term.

Subject	Grade 3	Grade 4	Grade 5
Arts	150 minutes	150 minutes	150 minutes
Community Living	150 minutes	180 minutes	210 minutes
Environmental Studies	180 minutes	210 minutes	210 minutes
Health	90 minutes	90 minutes	90 minutes
Language	570 minutes	450 minutes	405 minutes
Mathematics	210 minutes	210 minutes	210 minutes
Physical Education	105 minutes	135 minutes	150 minutes
Other			
Assembly	75 minutes	75 minutes	75 minutes
Religious Education	60 minutes	60 minutes	60 minutes
Block time	60 minutes	90 minutes	90 minutes
Total	**1650 minutes**	**1650 minutes**	**1650 minutes**

Appendix 3

Units of measurement

The table below shows the units of measurement that are used across the world. It shows the metric units, their symbols and the relationship between each unit.

Measurement	Units	Symbols	Relationships
Length	metre	m	10 mm = 1 cm
	centimetre	cm	100 cm = 1 m
	millimetre	mm	1000 mm = 1 m
	kilometre	km	1000 m = 1 km
Mass (Weight)	kilogram	kg	1000 g = 1 kg
	gram	g	1000 kg = 1 t
	tonne	t	
Capacity	litre	L	1000 mL = 1 L
	millilitre	mL	
Area	square metre	m^2	10 000 cm^2 = 1 m^2
	square centimetre	cm^2	10 000 m^2 = 1 ha
	hectare	ha	
Volume	cubic metre	m^3	1 000 000 cm^3 = 1 m^3
	cubic centimetre	cm^3	