

Inservice Units to Support the Implementation of the  
Primary Reform Curriculum

**Unit 4:  
Learning Areas: Mathematics  
and Science**

**Study Guide**



Department of Education



**Australian Government**

**AusAID**

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**For further information about the units contact the  
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# Inservice Units to Support the Implementation of the Primary Reform Curriculum

## Unit 4: Learning Areas: Mathematics and Science

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## Secretary's message

The Papua New Guinea Department of Education *In-service Management Plan 2001-2005* sets out the policies and practices for in-service to support the implementation of curriculum reform in basic education. The development of a culturally relevant curriculum and the provision of quality in-service for all elementary and primary teachers are fundamental components in the reform of basic education.

The provision of accessible, relevant and sustainable in-service training is critical for the effective implementation of the reform curriculum in Papua New Guinea schools. In particular, appropriately trained and skilled teachers, head teachers and support staff are the key.

These self-paced in-service units are being provided to assist teachers implement the primary reform curriculum materials distributed to schools in 2003 - 2005. They are quality materials designed to help each of you continue your professional learning at times to suit you and with the support of colleagues in your school and district. Significantly the units provide a means for all teachers to gain further qualifications through Papua New Guinea Education Institute and primary teachers colleges that may include these units as part of their in-service provision.

The units have been developed with the support of AusAID under the Curriculum Reform Implementation Project (CRIP).

I commend the units to you and invite you to take up the challenges provided by the availability of these units to continue your own learning so that we can be sure that our children receive the best possible education.



Dr. Joseph Pagelio  
A/Secretary for Education

## How to use the study guide

There are a number of ways you can use this study guide:

- As a source of information and activities for school-based, cluster or district learning and development (in-service), or
- As a study guide for self-improvement, or
- As a study guide to improve your qualifications

The decisions and choices you make as you work your way through this section of the study guide will determine the outcomes you achieve and the benefits you gain from your learning journey.

So be very clear about your purpose for studying this in-service unit.

### **Option 1. School-based, cluster or district learning and development**

This unit can be used to establish a learning community of practitioners in schools or across a cluster of schools (that is, to promote the practice of teachers studying together to improve their knowledge and skills and encouraging each other to do so).

To use this unit for school-based, cluster or district learning and development (in-service), first organise a planning group to scan the unit and module content to determine the most suitable approach. The planning group could comprise any of the following - the Head Teacher, the inspector, the in-service coordinator, a trained assessor, classroom teachers.

There are many ways in-service sessions could be organised, for example one to two hours every week, or a half day every month, or during NIST week or any other arrangement that suits the needs of your school, cluster or district.

The planning group may organise for teachers to work through the whole unit over a period of time or may select particular modules, sections or activities that will best help teachers implement the primary curriculum.

Teachers can work through the unit or modules themselves in pairs or in small groups, or they can be guided through the unit or modules by trained assessors or teachers who have already studied the unit at PNGEI.

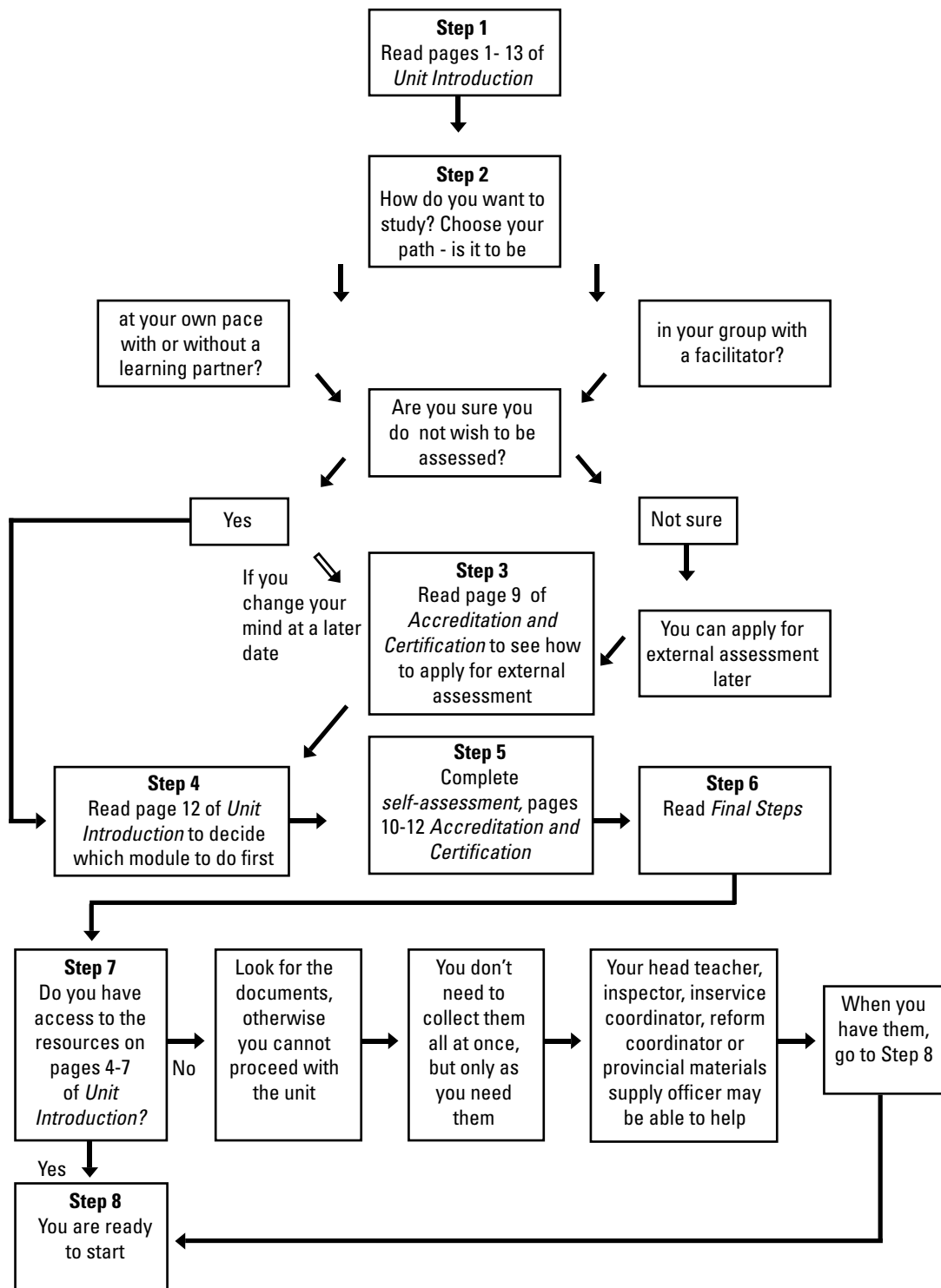
It is recommended that teachers do *self-assessment* of learning before and after each in-service activity. The self-assessment on page 13 of the *Accreditation and Certification* section can be used for this purpose.

### **Option 2. Self-improvement**

You may study this unit for your own self-improvement to become a more effective and informed teacher, senior teacher, head teacher, inspector or education officer with responsibility for curriculum reform.

If this is your goal, track your pathway through the flow chart on the next page.

**Study Pathway Planner for Self-improvement ....**

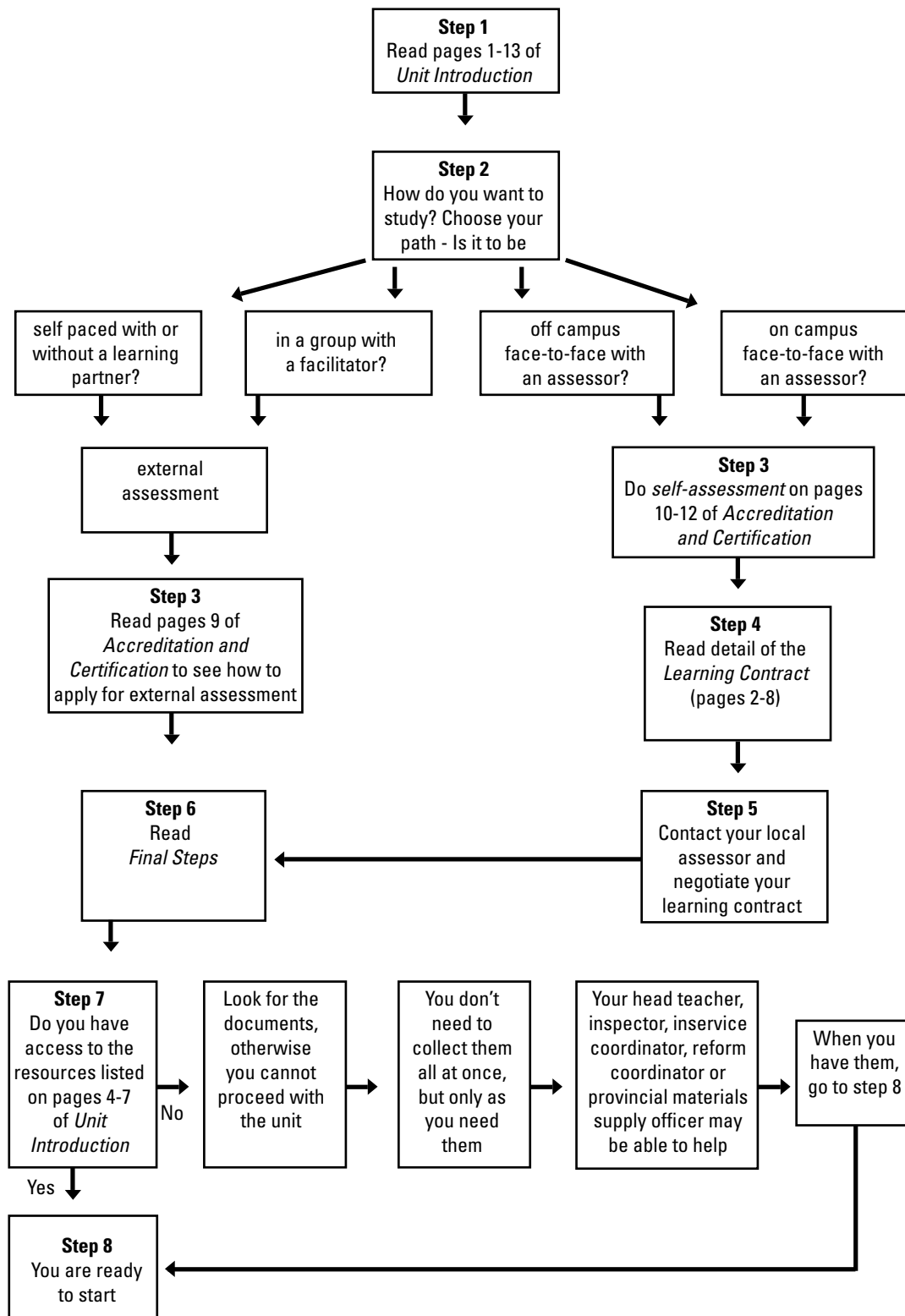


**Option 3. Improve your qualifications**

You may complete this unit to gain potential credit points to upgrade your qualifications through the DEP(I) or other programs offered by PNGEI such as Diploma in Special Education, Certificate of Elementary Teacher Training (CETT) or Diploma in Vocational Education (DOVET) or further education.

If this is your goal, track your pathway through the flow chart on the next page.

## Study Pathway Planner for Improving Qualifications...



# Unit Introduction

## The Context

This set of nine in-service units has been developed specifically to help primary school teachers, grades 3 - 8 and the senior teachers, head teachers, education officers and inspectors who support them, to effectively implement primary reform curriculum.

All primary syllabuses contain the Secretary's Message, Introduction, Rationale, Curriculum principles, Content overview, Course aims, Learning outcomes and Indicators and advice on assessment and reporting.

You are perhaps already familiar with terms such as introduction, rationale, curriculum principles and content overview and have an idea about what to expect. However, there is new information in all of these sections of the document.

The primary teacher guides explain to you, using examples, ways of planning and programming, ways of developing units of work and strategies and tools for assessment and reporting. They also provide information about the knowledge, skills, attitudes and values embedded in each of the outcomes through 'elaborations' of the outcomes. 'Suggested activities' are also to be found in this section.

The most significant aspect of the new syllabuses is that they describe student learning in terms of learning outcomes and indicators and not in terms of objectives as was the practice previously.

The learning outcomes specify what it is that students know, understand and are able to do as a result of their learning. Indicators list examples of the kinds of things students are able to do, know and understand if they are achieving an outcome. Teachers use indicators when they make judgements about student achievement of outcomes.

This set of in-service units uses an outcomes-based approach to help you become familiar with and to understand and experience learning based on specified outcomes. The in-service units introduce some new concepts and ideas based on effective principles of learning in an outcomes-oriented learning environment.

Learning outcomes are identified at two levels – unit learning outcomes and module learning outcomes. If academic credit is being sought through the study of a unit, the unit learning outcomes form the basis of assessment. If this is not the goal, then the unit learning outcomes may be used for checking own learning.

All units are developed through four modules. The modules are written in a 'self-learning mode'. You are guided each step of the way. Follow the instructions and you will be able to complete the modules.

In the *module summary*, at the end of each module, we have repeated the *module learning outcomes*. Use the list of outcomes as a checklist of your learning progress through the module.

In the *unit summary* at the end of the unit, we have repeated the *unit learning outcomes*. Use this as a checklist for your readiness for assessment.

We have provided space throughout the Study Guide for you to write your responses and reflections. This means that your study guide is also your *workbook* and your *learning journal*. Also, at the end of each module, you will find some blank pages. Use them as extra space for your notes if you need it.

We have not given any model answers for the various tasks you will be completing. Instead we have provided ‘hints’ to prompt your thinking. This may also help you check and re-think your responses.

Throughout the Study Guide you are advised to work with a colleague. The term **colleague** is used to mean a learning partner, a critical friend or a mentor. (Further information in this area may be found on page 4 of *Accreditation and Certification* section of this Study Guide.)

## Prerequisites

There are no academic prerequisites for this unit.

## Duration

It is likely to take you around 48 hours to complete all the *Learn, Do, Share* and *Reflect* activities in a unit.

## Learning tips

Each module includes *learning, doing, sharing* and *reflecting* activities. These are all designed to help you achieve the learning outcomes of the unit.

To complete the unit or modules you will need the resources with their pictures next to them listed on pages 4-7. All resources were sent to schools during 2003-2005.





## The learning model

The activities in this unit, using the learning model of *Learn, Do, Share* and *Reflect*, are designed to give you an understanding of the reform and develop your knowledge and skills in implementing it. The four parts of the learning model represent ongoing learning processes that form an integral part of the learning journey.

## Icons

An **icon** is a symbol used to show you what action to take in your learning journey. In this unit these icons represent this learning model.



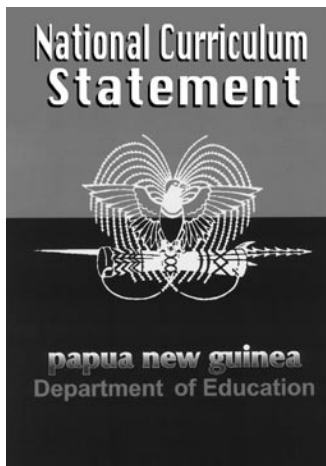
 <p><b>Learn (Lainim)</b></p> <ul style="list-style-type: none"> <li>• Find out more about</li> <li>• Use information to create knowledge</li> </ul>	 <p><b>Do (Wokim)</b></p> <ul style="list-style-type: none"> <li>• Do tasks</li> <li>• Practise skills</li> <li>• Apply new knowledge</li> </ul>
 <p><b>Share (Tok tok wantaim)</b></p> <ul style="list-style-type: none"> <li>• Talk to others about what you are learning</li> <li>• Discuss findings with a colleague, learning partner or group acting as a critical friend(s). Learning in cooperation increases the ability to learn. Discussing and exploring what has been learned with colleagues help in constructing knowledge through seeing, hearing, doing, talking, refining and reflecting.</li> </ul>	 <p><b>Reflect (Tingim bek)</b></p> <ul style="list-style-type: none"> <li>• Think critically about what you have learnt, done and shared</li> <li>• Think about changes to your practice</li> <li>• Think about changes to your beliefs and attitudes</li> </ul> <p>Reflection helps to make meaning from what is being done, develop shared meaning and challenge ways of thinking and doing things. Some reflective questions might be:</p> <ul style="list-style-type: none"> <li>- what does this mean for my practice in my current position?</li> <li>- what are the implications for the group?</li> <li>- what are the implications for the school or my classroom?</li> </ul>

## Resources

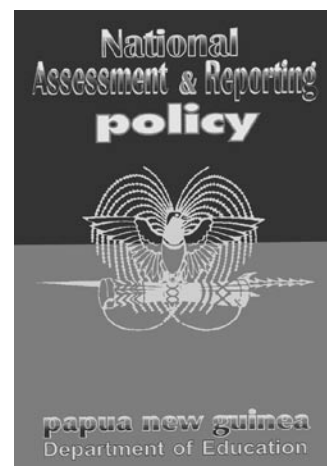
Here is a list of resource texts for use with this study guide. If you are currently teaching in the lower primary years, you may think of focusing on the lower primary syllabuses and related documents only. If you are currently teaching in the upper primary years, you may think of focusing on the upper primary syllabuses and related documents only. However, it is important that you become familiar with both sets of documents to become an effective and competent primary school teacher.

You will need access to the relevant documents to successfully complete the unit. These documents were distributed to schools in 2000 – 2005.

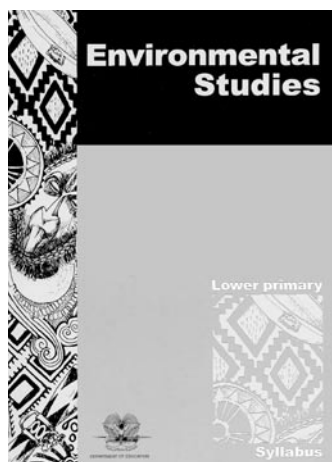
At the beginning of each module, the resource books you will need for that module are identified.



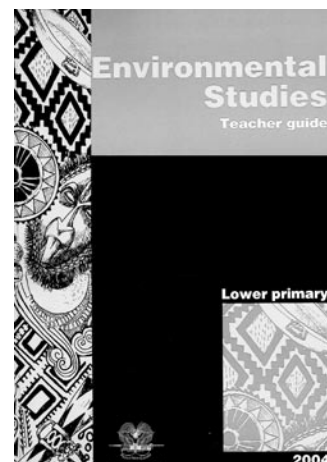
1. *National Curriculum Statement*, Department of Education, 2002, Papua New Guinea



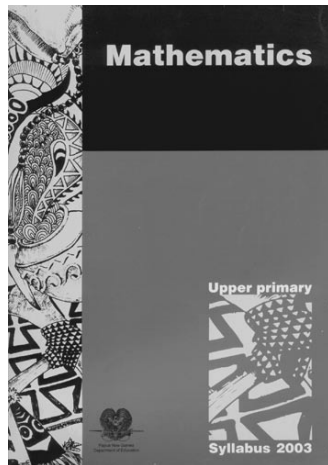
2. *National Assessment and Reporting Policy 2003*, Department of Education, Papua New Guinea



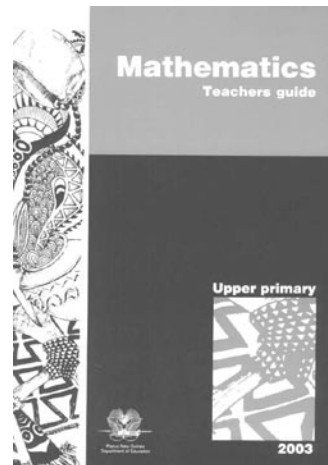
3. *Environmental Studies, Lower Primary Syllabus*, 2004, Department of Education, Papua New Guinea



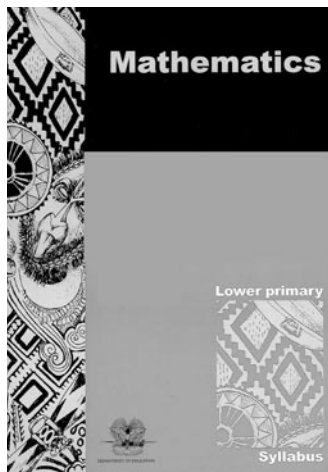
4. *Environmental Studies Teacher Guide, Lower Primary*, 2004, Department of Education, Papua New Guinea



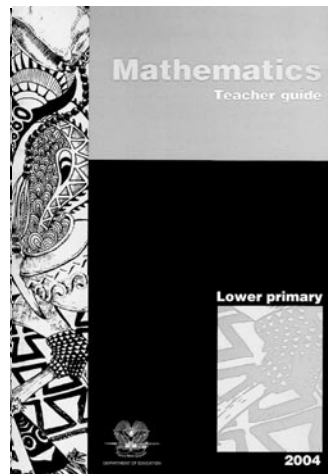
5. *Mathematics, Upper Primary Syllabus 2003*, Department of Education, Papua New Guinea



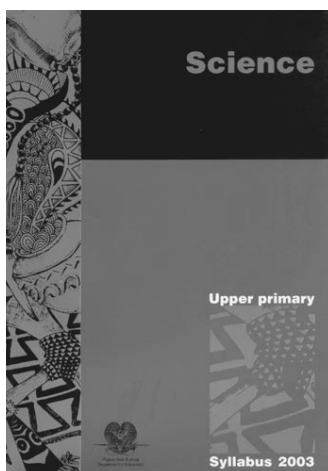
6. *Mathematics Teacher Guide, Upper Primary, 2003*, Department of Education, Papua New Guinea



7. *Mathematics, Lower Primary Syllabus, 2004*, Department of Education, Papua New Guinea



8. *Mathematics Teacher Guide, Lower Primary, 2004*, Department of Education, Papua New Guinea

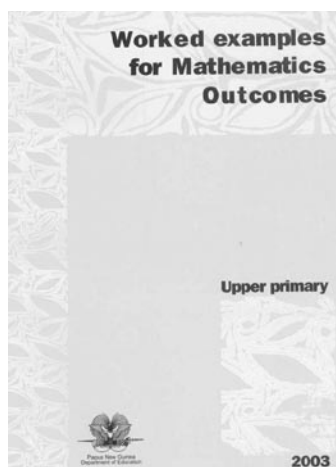


9. *Science, Upper Primary Syllabus, 2003*, Department of Education, Papua New Guinea



10. *Science Teacher Guide, Upper Primary, 2003*, Department of Education, Papua New Guinea





13. *Worked example for Mathematics Outcomes Upper Primary, 2003*, Department of Education, Papua New Guinea.

## About this unit

### The context

As you know, basic education is currently being reformed throughout the PNG education system. This process began some years ago. You might also be aware that some provinces and schools have already done a great deal of work in implementing the reform, while some others have a long way to go.

This unit is one of a set of nine in-service units developed to help both primary school teachers and those officers who support their work, such as, the senior teachers, head teachers, inspectors and education officers to understand and implement the reform in their work situation.

The in-service units in the set are:

Unit 1: Philosophy of Curriculum Reform

Unit 2: Learning Area: Culture and Community

Unit 3: Learning Areas: Language and Personal Development

Unit 4: Learning Areas: Mathematics and Science

Unit 5: Outcomes-Based Planning and Programming

Unit 6: Learning and Teaching for Outcomes

Unit 7: Assessing and Reporting Achievement of Outcomes

Unit 8: Bridging to English

Unit 9: Vernacular Literacies

You can study one or more units and you can study them in any order.

This unit focuses on the primary curriculum learning areas of **Mathematics and Science** and involves a close study of the following syllabuses and teacher guides.

*Mathematics, Lower Primary Syllabus*

*Mathematics, Upper Primary Syllabus 2003*

*Environmental Studies, Lower Primary Syllabus*

*Science, Upper Primary Syllabus 2003*

*Mathematics Teacher Guide, Lower Primary 2004*

*Mathematics Teachers Guide, Upper Primary 2003*

*Environmental Studies Teacher Guide, Lower Primary 2004*

*Science Teachers Guide, Upper Primary 2003*

Through these documents and others DoE makes clear that it is shifting its curriculum focus from objectives to outcomes.

This unit helps you understand outcomes-based education (OBE) as both an educational philosophy and a system for managing student-centred planning, programming, teaching, learning, assessing and reporting student learning. The unit takes you through the Mathematics and Science syllabuses and teacher guides and shows you how OBE is applied in your teaching practice. In OBE the outcomes are the same for all students. However, there is flexibility in the way they learn and demonstrate the outcomes. This approach caters for differences among students.

## The Mathematics Learning Area

*The Mathematics learning area has a major responsibility for the development of students' numeracy. Through a study of mathematics, students will learn to read, write and speak mathematics in a variety of contexts and forms. They will interpret and convey mathematical ideas, interpret texts containing mathematical forms and continue to use and learn mathematics. Every student needs to develop an awareness of the nature of mathematics, how it is created, used and communicated, for what purposes and how it influences and is influenced by what we believe and in the values we hold. New technologies have changed the level of complexity of mathematical problems encountered today as well as the methods that mathematicians use to investigate them. When students have opportunities to use technology, their growing curiosity can lead to richer mathematical invention. (National Curriculum Statement, 2002, page 37)*

The following table shows the subjects from elementary to upper secondary associated with this learning area. The columns that are highlighted show where the syllabuses covered in this in-service unit fit.

Learning Area	Elementary	Lower Primary	Upper Primary	Lower Secondary	Upper Secondary
Mathematics	Cultural Mathematics	Mathematics	Mathematics	Mathematics	Mathematics Extension (Maths A) Mathematics Core (Maths B) Life Maths

**Table: Subjects included in the Mathematics Learning Area**  
(National Curriculum Statement, Page 38)

## The Science Learning Area

*The learning area of Science involves ways of exploring, knowing and understanding the underlying principles that shape our world. Science education assists students to make informed and responsible decisions about their lifestyles, environment and the kind of societies in which they choose to live. It does this by encouraging the use of evidence in decision making, a questioning attitude and an ability to look at the relationships between the information needed to solve the problems that confront people daily. (National Curriculum Statement, 2002, page 40)*

Learning Area	Elementary	Lower Primary	Upper Primary	Lower Secondary	Upper Secondary
Science	Aspects of Science are covered under Culture and Community	Environmental Studies	Science	Science Environmental Science Applied Science	Biology Chemistry Physics Applied Science

**Table: Subjects included in the Science Learning Area**  
*(National Curriculum Statement, Page 41)*

## Unit learning outcomes

Learning outcomes are statements about the knowledge, understandings, and skills you have achieved and are able to demonstrate when you have worked through the unit. These statements are learner-centred and written in terms that enable them to be demonstrated, assessed or measured.

On successful completion of this unit, you, the learner, can (are able to)

1. describe the structure and contents of the syllabuses and teacher guides in the Mathematics and Science learning areas
2. identify links between the syllabuses and the corresponding teacher guides
3. make connections between the Mathematics and Science learning areas
4. describe and discuss ways progress from grade 3 to grade 8 is described in the Mathematics and Science learning areas
5. use the syllabuses and teacher guides to construct units of work based on learning outcomes
6. make links between the syllabuses and teacher guides and the *National Curriculum Statement (2002)* and the *National Assessment and Reporting Policy, 2003*
7. assist others to understand and use these syllabuses and teacher guides.

## The Modules

In order to help you achieve the unit learning outcomes, *Unit 4: Learning Areas: Mathematics and Science* is developed through four modules.

The modules are linked. This means that you must do them in the order in which they are presented, starting with Module 1.

An overview of each of the modules follows:

### **Module 1: Introducing the Mathematics and Science Learning Areas**

In this module you are introduced to introductory sections of the lower and upper primary syllabuses and teacher guides in the Mathematics and Science learning areas. The major focus of this module is the structure and the contents of the syllabuses and their relevant teacher guides. You consider how the syllabuses progress from lower primary to upper primary, identifying descriptions of progress. You make connections between the syllabuses, the teacher guides and the policy documents.

### **Module 2: Learning Outcomes, Indicators and Elaborations**

In this module you are encouraged to explore the connections between the outcomes, indicators and elaborations in the syllabuses and teacher guides. Through the activities provided, you clarify their importance and apply them in various aspects of your practice as a teacher or one who supports and supervises teachers.

### **Module 3: Learning and Teaching, Assessing and Reporting**

In this module you focus on the learning and teaching strategies identified in the Mathematics syllabuses and teacher guides and the Science syllabuses and teacher guides separately and then make connections between them.

Another focus of this module is the assessment and reporting ideas provided in the two sets of syllabuses and teachers guides. You look at them separately and then make connections between them.

### **Module 4: Applying your learning – developing units of work**

In this module you consider implications for practice. Using selected outcomes, you plan a unit of work relevant to your work context and based on knowledge you have gained in the preceding modules.

## References

**These documents have been used in writing these units. You do not need to have access to these documents.**

Curriculum Development Division (undated), *The Reform of Basic Education: Elementary and Primary School, Prep to Grade 8*.

Curriculum Reform Implementation Project, 2002, *Professional Reading Series No. 1, 2 and 3*, In-house documents.

Department of Education, 2001, *In-service Management Plan 2001-2005, Supporting the implementation of curriculum reform from Elementary Prep to Grade 8*, Papua New Guinea.

Department of Education, March 2002, *The State of Education in Papua New Guinea*, Papua New Guinea.

Department of Education, 2002, *In-service Units to Support the Implementation of Lower Primary Reform Curriculum*, Papua New Guinea.

1. Curriculum Reform and Lower primary Curriculum
2. Bridging to English in Lower primary
3. Planning and Programming
4. Teaching and Learning
5. Assessment and Reporting

Department of Education, 2003, *In-service Units to Support the Implementation of Upper Primary Reform Curriculum*, Papua New Guinea.

1. Philosophy of Curriculum Reform
2. Curriculum Reform and Upper Primary Reform Curriculum
3. Outcomes-based Planning and Programming
4. Learning and Teaching for Outcomes
5. Assessing and Reporting Achievement of Outcomes

Killen, R (2002). *Outcomes-Based Education: Principles and Possibilities*. Interpretations, 35 (1), 1-18.

NSW Department of Education and Training, 1999, *Quality Teaching Learning Materials (QTML)*.