# **Beginning School Mathematics**

A Guide to the Resource

**Ministry of Education** 

Learning Media Wellington Learning Media wishes to thank Denise Whitehead and

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## **Beliefs About Mathematics Learning**

The teaching of mathematics in New Zealand classrooms is based on the following beliefs.

- Children experience mathematical ideas, and develop mathematical skills and understandings, before they start school.
- Children learn by relating new ideas to their existing experiences and ideas.
- Children learn best when ideas are presented in realistic and meaningful contexts.
- Effective mathematics teaching involves a range of approaches.
- Children learn in different ways at different rates.
- Concepts can be presented in a variety of ways to match different learning styles.
- Learning involves taking risks in a supportive environment.
- The learner must be at the heart of all planning.
- Feedback can take many forms, and is an essential part of the learning process.
- Critical reflection and effective communication of ideas are essential learning tools.

## Introduction

Beginning School Mathematics is an activity-based resource designed to support the teaching and learning of mathematics in the early years. It comprises a wide range of materials, including teachers' guides, booklets for pupils, card equipment for many of the activities, and overview charts that allow the teaching objectives to be viewed in the wider context. A key feature of the design of BSM is the flexibility with which it can be used, allowing teachers to choose from a range of teaching approaches, and to adapt the activities, or incorporate new ones, to suit the diverse needs of children. The philosophy and content of this resource provide teachers with valuable support in their implementation of *Mathematics in the New Zealand Curriculum*.

BSM has been designed to support and empower teachers. The possibilities and potential of this resource are as flexible as the teacher, who continues to hold the key to its effective use.

- BSM In Your Classroom (introductory statement in Cycles 8-12)

## The Shape and Content of the New Zealand Curriculum

Two major documents provide a basis for the initiative to improve the teaching and learning of mathematics in New Zealand schools.

### The New Zealand Curriculum Framework

This document contains the official policy for teaching, learning, and assessment in New Zealand schools. It provides a coherent framework for the more specific national curriculum statements, which describe in detail the knowledge, skills, understandings, and attitudes from seven essential learning areas necessary for a broad and balanced education. Mathematics is one of these essential learning areas.

### Mathematics in the New Zealand Curriculum

This national curriculum statement specifies achievement objectives at eight levels (through all the years of schooling) and provides suggested learning experiences and examples of assessment activities for mathematics programmes in New Zealand schools. Throughout, there is an emphasis on providing learning experiences which are meaningful to students and which lead to an understanding of the many applications of mathematics in the world beyond school.

The Beginning School Mathematics resource outlined in this booklet will support teachers as they implement *Mathematics in the New Zealand Curriculum* in relation to *The New Zealand Curriculum Framework*. BSM has been developed and trialled in consultation with New Zealand teachers. The principles and content reflect the knowledge and experience of a wide range of educators in the light of the best current practice.

An important aspect of *Mathematics in the New Zealand Curriculum* is its focus on the mathematical processes skills. These skills — problem solving, reasoning, and communicating mathematical ideas — are experienced through the concepts of number, measurement, geometry, algebra, and statistics.

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Communicating Mathematical Ideas		ent			

The processes skills place an increased emphasis on children

- posing questions for mathematical exploration
- communicating the results of their mathematical explorations
- using calculators and computers in correct and appropriate ways
- exploring probability.



## **Beginning School Mathematics in Your Classroom**

The BSM resource has been designed to help teachers to respond to children's needs, while, at the same time, providing a base from which teachers can become competent and confident in teaching mathematics. The aim of this resource is to develop children who can

- recognise, explore, and enjoy mathematics in everyday situations
- solve problems in a variety of ways
- apply skills and transfer knowledge
- interact and co-operate with others
- take responsibility for their own learning
- communicate their findings in many ways
- feel good about themselves as successful learners of mathematics.

The following key points embody the important features of the BSM resource.



## **The Structure of Beginning School Mathematics**

The BSM resource is cyclic in design. Each successive cycle introduces and develops new learning objectives as well as reinforcing ideas and skills from children's previous work.

There are twelve cycles altogether. Each cycle is divided into three modules. The strands from *Mathematics in the New Zealand Curriculum* are covered within this structure.



In each cycle:

- Module 1 focuses on number, algebra, and statistics
- Module 2 focuses on geometry, measurement, and number
- Module 3 focuses on number, algebra, geometry, logic, and reasoning.

The mathematical processes skills — problem solving, reasoning, and communicating mathematical ideas — are learned and assessed within the context of the more specific knowledge and skills of number, measurement, geometry, algebra, and statistics.

- from Mathematics in the New Zealand Curriculum, page 23

Each cycle is accompanied by a checkpoint booklet which can be used in a variety of ways to assess individual children's understanding of key ideas in the cycle.

## The Components of Beginning School Mathematics

The BSM resource has five major components.



## **Overview Charts**

There are two overview charts, one covering Cycles 1 to 6 and the other Cycles 7 to 12. The charts are essential planning documents, showing clearly where an idea is introduced or where the development of an idea occurs. The objectives from the twelve cycles are presented on the charts in a way that makes the development of ideas over time an easy process to follow. The format also emphasises how the mathematical ideas link with the strands identified in *Mathematics in the New Zealand Curriculum*.

The overview charts will

- help teachers to understand the development of ideas in terms of the overall resource
- assist in planning and preparation
- be a useful support at parent conferences.

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allows teachers and parents to see where a child is working within the whole resource

strands

### **Teachers' Books**

The key component of each module is a teachers' book which contains aims, objectives, information on mathematical ideas, and a selection of numbered activities. The introduction of the booklet outlines

- the spirit of the module
- the key content
- notes for the teacher
- notes on the mathematical ideas to be introduced.

Note: In Cycles 1 to 6 there are separate teachers' books for each module. In Cycles 7 to 12, the teachers' material for the three modules of each cycle is in a single book.

The objectives for the module are presented in table form, and are linked with their associated activities.

- Core activities, numbered 1 to 20, are designed to be used by the teacher working with a group of children.
- Class activities, numbered 21 to 40, provide the opportunity for the teacher to supplement the core activities.
- Independent activities, numbered 41 to 80, are designed to provide maintenance for ideas covered previously.
- Extension activities, numbered from 81 onwards, provide a challenge for children who show a mastery of particular ideas.

The numbering system is consistent throughout the resource, and allows components to be easily identified for borrowing or reshelving. Although the numbering system supports a structured use of the materials, it also allows for flexibility.



The emphasis throughout the resource should be on the objectives, and on helping children to achieve them. The activities contain mathematical information, ideas, and suggestions for teachers. Teachers should feel at liberty to alter or adapt activities, to supplement them, or to develop and collect other activities which are particularly suitable for their children, community, or environment. — BSM In Your Classroom (introductory statement in Cycles 8-12)

### Checkpoints

The checkpoint booklets that accompany each cycle suggest two methods of assessing children's progress — day-to-day monitoring, and checking children's understanding of key ideas. Through these two approaches, teachers can plan appropriate ways to meet the assessment needs of children learning at various rates. By using the checkpoint, a teacher can assess the child's understanding of some of the ideas introduced in that cycle. For each checkpoint, relevant objectives and necessary equipment are shown, and a range of questions is suggested. The booklet also contains day-to-day recording sheets for each module, showing objectives with their associated activities, and providing space for teachers' anecdotal notes.

### Children's Booklets

Booklets for the children's own use are first introduced in Cycle 7. They are designed to extend the children's knowledge and skills and to provide further opportunities to develop responsibility and independence in learning. In some cases, the games and activities require items of BSM card equipment, or other standard mathematics equipment, such as Cuisenaire rods or counters.

The booklets also provide children with a first "maths book" and give them practice in following written and pictorial instructions.

## Equipment — Card Equipment and Hardware

### Card Equipment

Card equipment is supplied to match particular activities in the resource. It is numbered to match the activity.



Some of the card equipment, such as number cards and digit labels, are for use across the twelve cycles.

Card equipment for a cycle may also include

- copymasters and recording sheets for the children's use
- direction cards (for some activities) designed to be read, interpreted, and followed by the children independently.

### Hardware

BSM hardware, and other standard mathematical equipment required for BSM activities, is described in the teachers' books. These materials are not available from Learning Media, but can be obtained from local reputable suppliers of education equipment.

## **The Spirit of Each Module**

The "Spirit of the Module" statements, found in the introduction to each teacher's book, summarise the intent of each module. These statements are useful when cross referencing the BSM resource with the achievement objectives in *Mathematics in the New Zealand Curriculum*.

Cycl	e 1	2	3
Module 1	Children explore a wide range of natural and environmental materials individually and informally. These experiences continue the way in which children gained early mathematical ideas before they entered school.	Children develop the idea of comparison and the ability to make discoveries based on this idea.	As the children match pairs of related objects, number groups, lengths, and weights, they demonstrate an increasing understanding of relationships.
Module 2	Children have experiences similar to those in which they have explored spatial relationships and shapes before they entered school. They develop the related language.	As children are physically involved in exploring situations within a structured setting, they develop the ideas and language of shape, movement, and position.	As the children construct shapes, and move their bodies and objects in different directions and to particular places, they extend their spatial understanding.
Module 3	Children explore the properties of everyday objects to make them aware of likenesses, differences, and order.	Children are helped to become aware of patterns, their variety and structure. They begin to put their knowledge of likenesses and differences to use.	As children discover that an object has several attributes, they widen their bases for classifying.

4	5	6
As children compare number groups, they begin to understand relationships between numbers.	As the children use their enumeration skills, classify sets for number property, and explore number patterns within sets, they begin to understand the constancy of a number.	As children study each number group in depth, they bring together an understanding of the constancy of each number, its position in the series of counting numbers, and its relationship to other numbers.
Children are involved co- operatively in finding answers to questions about position, distance, time, length, and weight.	Children's spatial understanding is increased through shape and movement activities that involve direction and orientation, and also through a variety of measuring tasks.	Children discover that there are many three- and four-sided shapes. They learn new ways of measuring weight and capacity by using identical objects and containers.
As children begin to use pictorial symbols and stylised number patterns to label sets, their classification skills develop further.	Children have experience in solving problems by recognising the structures in the materials used, making choices, and deciding whether these are appropriate.	Children's ability to solve problems is further developed by the teacher's questions. The children suggest various solutions to problems and demonstrate these with equipment.

Cycl	e 7	8	9
Module 1	Children's experience with numbers is extended as they join sets and describe the addition operation.	Children's understanding of relationships, the constancy of numbers, and the addition operation is shown as they make relationship charts and picture graphs independently, and record names for a number, and addition equations.	As children are encouraged to bring their own ideas into mathematics and record in their own ways, they begin to see mathematics as a part of everyday life and to understand that facts remain the same, regardless of how they are recorded.
Module 2	Children's exploration of spatial relationships is related closely to measurement as they cover surfaces with shapes and make judgements about distances.	Children's understanding of measurement is demonstrated by their ability to estimate, and then measure accurately with suitable unconventional units.	Children continue to explore unconventional measures, while using conventional measures informally. They are encouraged to judge the appropriateness of particular measures.
Module 3	Children study a set to name its attributes, including number property, or to see patterns of number groups within a set of a particular number.	Children's thinking is extended by further experiences with inclusion and intersection in classification activities, and by the ideas of opposite actions and reverse order in number operations.	Children are encouraged to record in their own ways and experiment with other ways. They should, at the same time, meet more formal types of recording. Some are beginning to see that conventional forms of recording are necessary for precise and standardised communication.

10	11	12
The children continue to refine their thinking in mathematics. As they work at solving problems, they develop further strong links between the use of concrete materials and formal recording.	As children work with ideas introduced in previous modules, they have further opportunities to work in the abstract, as well as continuing to work with concrete materials.	As children work with numbers in the higher decades, they are encouraged to explain their thinking and recording to other children, and to use a range of materials to show the same idea.
Children are consolidating concepts of measurement of length, weight, capacity, and time as they use both conventional and unconventional measures in these areas.	As the children move, measure, and label, they realise that they use many ideas and skills to solve a problem, and that some skills are more relevant than others.	As the children work with conventional measures of length, distance, weight capacity, time, and money, they widen their experience of mathematics in everyday life.
As the children work with the activities in this module, they link ideas from previous modules to solve problems in new contexts. They are further encouraged to look for the mathematics in everyday situations.	The children work with number and operations, estimating the numbers in larger sets, and looking for exceptions that could disprove a statement.	As children work through this module, they continue to use concrete material but begin to rely more on their ability to work using only the symbols.

## **Assessment and Evaluation**

Assessment should focus on both what children know and can do, and on how they think about mathematics.

Assessment should be integral to the normal teaching and learning programme.... [It] should involve multiple techniques, including written, oral, and demonstration formats. Group and team activities should be assessed.

It is expected that, in assessing students' progress, teachers will make judgments as to an individual's degree of achievement of particular objectives, and will include commentary on that degree of achievement when reporting to parents.

- Mathematics in the New Zealand Curriculum, pages 15 and 16

### **Day-to-day Recording**

Anecdotal and/or checklist recording, based on observation and informal discussion, can be used to assess the child's achievement of the objectives. By observing and interacting, teachers can gain a great deal of information on each child's progress. If this information is recorded, it can be used to pace children and to plan for further learning. Children will progress at their own rate, and ongoing observation will help to meet their individual needs.

### Checkpoints

Checkpoints can be used in a variety of ways to check individual children's understanding of some of the ideas in a cycle. Guidelines on purpose and use can be found in each checkpoint.

Points to think about.

- How will you collect data that demonstrates the child's degree of achievement of the objective?
- Are you using a variety of assessment techniques?
- What retainable evidence will you collect? How will you collate this information?
- What are the school's policy requirements for assessment and evaluation?

## **Classroom Planning and Organisation**

There are various ways to approach programme planning. Whichever approach you adopt, be mindful of the following questions.

- Is the learner at the heart of your planning?
- Does your current planning reflect the requirements of *Mathematics in the New Zealand Curriculum?*
- Does your current system for the storage of resources allow for easy access?
- Have you considered a range of planning options? For example:

• Do I need to supplement my group box with other activities to maintain previous learning?

- I know there is an appropriate class activity in 3.1 that supports this idea.
- During this unit, how can I gather data for assessment purposes?
- Will there be an opportunity during the day to develop this idea further?

• What would be the best way to group the children?

• What context will I use to make this personally meaningful to the children?

• I think the problem-solving process "use equipment appropriately when exploring mathematical ideas" would link in here.

• What could I use as a starter problem to get the children thinking mathematically and help me determine readiness?

- What will I focus on for assessment?
- If the children design a chart, should I keep it for assessment purposes?
- What BSM objectives and activities would help as we work towards this idea?
- This relates to our science unit on kites.
- What other resources do we have that could be used here?
- This idea fits in with the measurement topic from Module 2, and we will revisit it during Module 3.

A balanced mathematical programme includes concept learning, developing and maintaining skills, and learning to tackle applications. These should be taught in such a way that students develop the ability to think mathematically.

- Mathematics in the New Zealand Curriculum, page 11

## Looking at One BSM Activity

Mathematics in the New Zealand Curriculum Measurement Strand, Levels 1 and 2

Achievement Objectives

- Carry out practical measuring tasks, using appropriate metric units for length, mass, and capacity.
- Use equipment appropriately when exploring mathematical ideas.
- Use their own and mathematical language to explain mathematical ideas.

# Objective Six – Activity

## Objective 6

Associate the term: litre with capacity

### 6 A litre is a very big drink.

### Materials

- A large container that holds approximately 1 litre, e.g., a large preserving jar. 8 identical yoghurt containers. A litre of orange drink or milk.

## Activity (up to 8 chidren)

- we buy in litres, e.g., petrol, oils, drinks, detergent.
- Talk briefly about "all that drink" being 1 litre. Discuss the sorts of things Use a real life situation to fit the next part of the activity.
- Ask the children to share out the drink into the yoghurt containers Talk about each child having the same quantity.

Tip it all back and emphasise that altogether it would be a very big drink! Share it out again and let the children drink their share.

This activity from Cycle 8 Module 2:

- allows for the use of prior knowledge
- provides a relevant context
- lets the teacher explore the child's concept of a litre
- relates learning to the child's own experiences and ideas
- allows children to explore concepts and skills
- promotes active learning
- allows children to take risks
- enables the learner to reflect on actions and experiences
- provides a situation where children can work as a team to carry out a mathematical exploration.

Think of other ways that this objective could be developed.

- Use a variety of containers to develop the concept of measurement.
- Relate the objective to a real-life context where liquid is measured in litres.
- Integrate the objective with a science unit which requires the measurement of liquid.
- Allow the children to think of different situations or problems to develop this objective, for example, "How can we find out how much drink there is in our group's drink bottles?"
- Work across strands.

## **Enhancing Mathematics Learning**

The greatest resource of all is the children themselves. These children bring a rich tapestry of knowledge and experiences to the classroom. They have already encountered and used mathematics in their own lives, within contexts that are personally meaningful. Our challenge, as teachers, is to provide an environment that presents realistic learning situations that allow children to continue weaving their tapestry.

The requirements of the *New Zealand Curriculum Framework* and *Mathematics in the New Zealand Curriculum*, and the philosophy of the BSM resource, have implications for how mathematics learning can best be enhanced.

### **Classroom Environment**

The role of the teacher is to create a positive learning environment by:

- engaging children in meaningful and purposeful tasks
- modelling strategies for working with specific skills and problems
- demonstrating a positive attitude to mathematics
- providing time for thinking, reflecting, reacting, and sharing
- expecting children to be able to: solve problems work co-operatively take responsibility take risks reason logically communicate mathematically estimate and check the reasonableness of answers.

### Resources

There are various resources available to support the concepts being developed from *Mathematics in the New Zealand Curriculum*. Beginning School Mathematics is one resource and can be supplemented by others. Teachers need to evaluate any resources used according to the needs of their pupils.

### Parents and BSM

Teachers need to communicate ways in which home and school can work together to support children as they learn mathematics. The leaflet *Beginning School Mathematics: A Pamphlet for Parents* provides some starting points, and suggests a range of ways in which parents can encourage children in their developing understanding of mathematics.

Further support is available through Teacher Support/Advisory Services and branches of the Family Maths Trust.

The contribution of teachers, advisers, and children has been a major factor in the trialling and development of BSM. Educators throughout New Zealand are exploring a variety of options for using the BSM resource to support *Mathematics in the New Zealand Curriculum*. Beginning School Mathematics, alongside other resources, is an invaluable support for mathematics teaching and learning in junior classrooms.