# Mathematics Primary

*Guide*

NOVA SCOTIA
NOUVELLE-ÉCOSSE

2019

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Mathematics Primary

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Prepared by the Department of Education and Early Childhood Development

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# Mathematics Primary

**Draft**
**2019**

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Mathematics Primary, Draft

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# Contents

# Introduction

## Background and Rationale

Mathematics curriculum is shaped by a vision that fosters the development of mathematically literate students who can extend and apply their learning and who are effective participants in society. It is essential that the mathematics curriculum reflect current research in mathematics instruction. To achieve this goal, Western and Northern Canadian Protocol's (WNCP) *The Common Curriculum Framework for K–9 Mathematics* (2006) has been adopted as the basis for the mathematics curriculum in Nova Scotia.

*The Common Curriculum Framework* (WNCP 2006) was developed by the seven ministries of education (Alberta, British Columbia, Manitoba, Northwest Territories, Nunavut, Saskatchewan, and Yukon Territory) in collaboration with teachers, administrators, parents, business representatives, post-secondary educators, and others. The framework identifies beliefs about mathematics, general and specific student outcomes, and performance indicators agreed upon by the seven jurisdictions. The outcomes and performance indicators have been adapted for Nova Scotia. This document is based on both national and international research by the WNCP and the National Council of Teachers of Mathematics (NCTM).

There is an emphasis in the Nova Scotia curriculum on particular key concepts at each grade that will result in greater depth of understanding and, ultimately, stronger student achievement. There is also a greater emphasis on number sense and operations concepts in the early grades to ensure students develop a solid foundation in numeracy.

## Purpose

This document provides sets of outcomes and performance indicators to be used as a mandated common base for defining mathematics curriculum expectations. This common base should result in consistent student outcomes in mathematics within the province of Nova Scotia. It should also enable easier transfer for students moving within the province or from any jurisdiction that has adopted the WNCP framework. This document is intended to clearly communicate to all education partners across the province the high expectations for students' mathematical learning.

# Program Design and Components

## Assessment

Ongoing assessment for learning is essential to effective teaching and learning. Research has shown that assessment for learning (formative assessment) practices produce significant and often substantial learning gains, close achievement gaps, and build students' ability to learn new skills (Black & Wiliam 1998; OECD 2006). Student involvement in assessment promotes learning. Timely and effective teacher feedback and student self-assessment allow students to reflect on and articulate their understanding of mathematical concepts and ideas.

Assessment in the classroom includes
- providing clear goals, targets, and learning outcomes
- using exemplars, rubrics, and models to help clarify outcomes and identify important features of the work
- monitoring progress towards outcomes and providing feedback as necessary
- encouraging self-assessment
- fostering a classroom environment where conversations about learning take place, where students can check their thinking and performance and develop a deeper understanding of their learning

(Davies 2000)

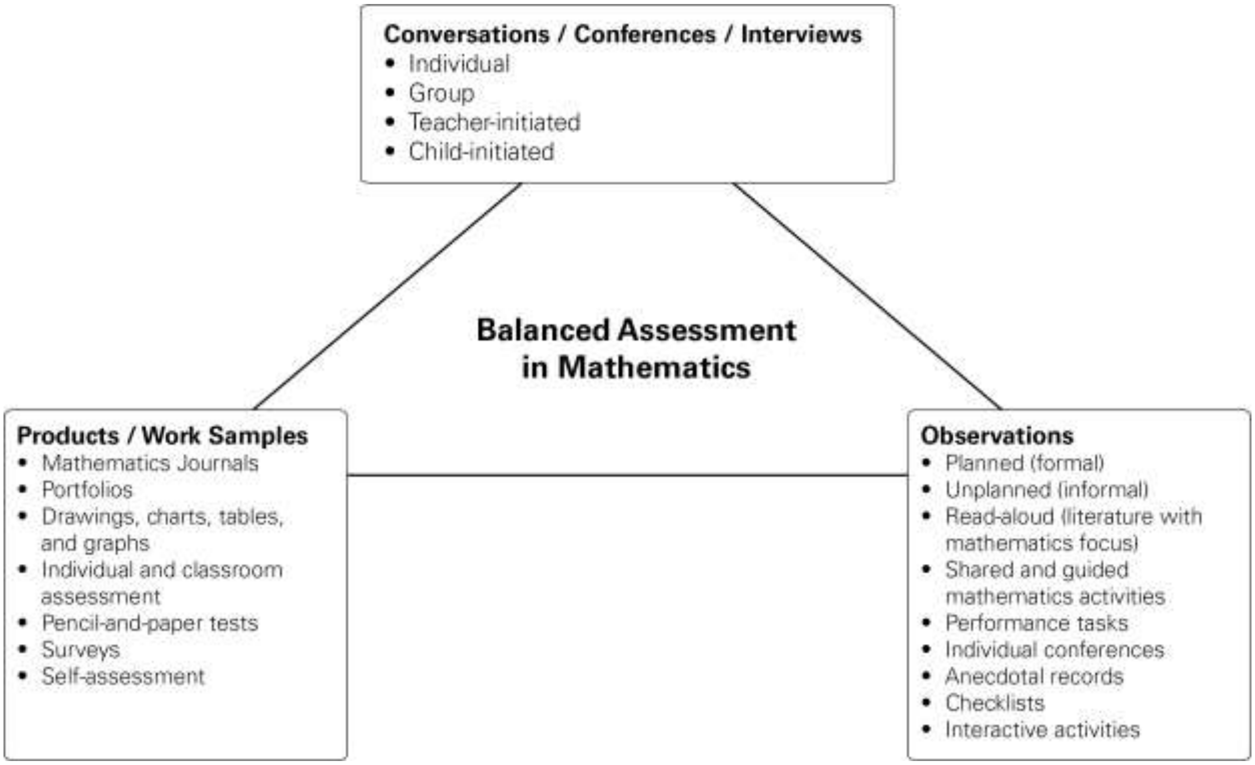
Assessment for learning practices act as the scaffolding for learning, which only then can be measured through assessment of learning (summative assessment). Assessment of learning tracks student progress, informs instructional programming, and aids in decision making. Both forms of assessment are necessary to guide teaching, stimulate learning, and produce achievement gains.

Assessment of student learning should
- align with curriculum outcomes
- clearly define criteria for success
- make explicit the expectations for students' performance
- use a wide variety of assessment strategies and tools
- yield useful information to inform instruction

Cognitive levels of questions in mathematics are defined as:
- Knowledge questions may require students to recall or recognize information, names, definitions, or steps in a procedure.
- Application/comprehension questions may require students to make connections, represent a situation in more than one way (translating between representations), or solve contextual problems.
- Analysis questions may require students to go beyond comprehension and application to higher order thinking skills, such as generalizations and non-routine problem solving.

Classroom assessment and instruction should incorporate tasks with varied levels of cognitive demand. The recommended percentages for questions used in classroom-based assessments and instruction are:
- Knowledge 20–30%
- Application / Comprehension 50–60%
- Analysis 10–20%

Assessment evidence may be gathered through conversation and interviews, observations, and products.




# Time to Learn for Mathematics

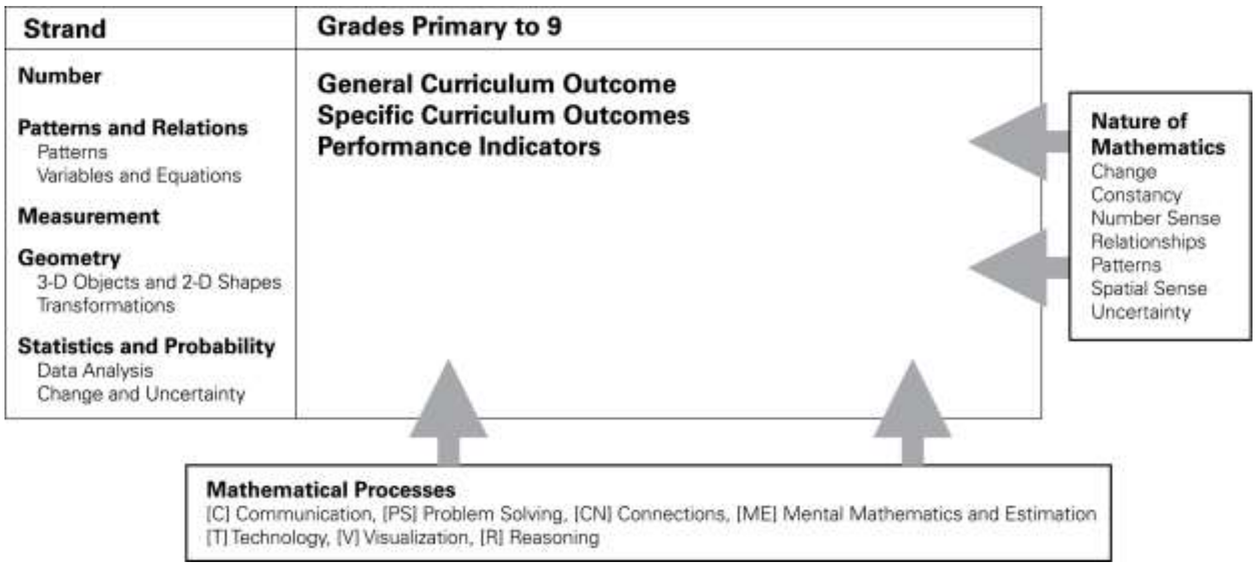
The *Plan for Instruction Revised Time to Learn Strategy: Grades Primary*–3 (Nova Scotia Department of Education 2015) and *Revised Time to Learn Strategy: Grades 4*–6 (Nova Scotia Department of Education 2016) requires a block of time for mathematics instruction each day. In order to support a constructivist approach to teaching through problem solving, 90 minutes of mathematics instruction is required daily in grades primary–6. It is recommended that this instruction be provided in an uninterrupted block of time.

Time to Learn guidelines can be found at
www.ednet.ns.ca/files/ps-policies/semestering.pdf
The Time to Learn Plan for Instruction document for Grade P-3 can be found at:
https://www.ednet.ns.ca/files/curriculum/Time2Learn-Rev-June25-2015.pdf

# Outcomes

## Conceptual Framework for Mathematics Primary–9

The chart below provides an overview of how mathematical processes and the nature of mathematics influence learning outcomes.




(Adapted with permission from Western and Northern Canadian Protocol, *The Common Curriculum Framework for K–9 Mathematics*, p. 5. All rights reserved.)

## Structure of the Mathematics Curriculum

### Strands

The learning outcomes in the Nova Scotia Framework are organized into five strands across grades primary to 9.

- Number (N)
- Patterns and Relations (PR)
- Measurement (M)
- Geometry (G)
- Statistics and Probability (SP)

## General Curriculum Outcomes (GCO)

Some strands are further subdivided into sub-strands. There is one general outcome (GCO) per sub-strand. GCOs are overarching statements about what students are expected to learn in each strand/sub-strand. The general curriculum outcome for each strand/sub-strand is the same throughout the grades.

### Number (N)

GCO: Students will be expected to demonstrate number sense.

### Patterns and Relations (PR)

**Patterns**
GCO: Students will be expected to use patterns to describe the world and solve problems.

**Variables and Equations**
GCO: Students will be expected to represent algebraic expressions in multiple ways.

### Measurement (M)

GCO: Students will be expected to use direct and indirect measure to solve problems.

### Geometry (G)

**3-D Objects and 2-D Shapes**
GCO: Students will be expected to describe the characteristics of 3-D objects and 2-D shapes and analyze the relationships among them.

**Transformations**
GCO: Students will be expected to describe and analyze position and motion of objects and shapes.

### Statistics and Probability (SP)

**Data Analysis**
GCO: Students will be expected to collect, display, and analyze data to solve problems.

**Chance and Uncertainty**
GCO: Students will be expected to use experimental or theoretical probabilities to represent and solve problems involving uncertainty.

The Mathematics Primary curriculum contains outcomes from four strands—Number (N), Patterns and Relations (PR), Measurement (M), and Geometry (G).

Statistics and Probability (SP) outcomes are not part of the Mathematics Primary curriculum. Data analysis outcomes are introduced in Mathematics 2. Chance and uncertainty outcomes are introduced in Mathematics 5.

## Specific Curriculum Outcomes (SCOs) and Performance Indicators

Specific curriculum outcomes (SCOs) are statements that identify the specific conceptual understanding, related skills, and knowledge students are expected to attain by the end of a given grade.

Performance indicators are statements that identify specific expectations of the depth, breadth, and expectations for the outcome. Teachers use these statements to determine whether students have achieved the corresponding specific curriculum outcome.

**Process Standards Key**

| | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

### NUMBER (N)

**N01** Students will be expected to say the number sequence by

- 1s, from 1 to 20
- 1s, starting anywhere from 1 to 10 and from 10 to 1 [C, CN, V]

**Performance Indicators**

N01.01 Recite the number sequence from 1 to 20 and from 10 to 1.
N01.02 Name the number that comes after a given number, 1 to 9.
N01.03 Name the number that comes before a given number, 2 to 10.
N01.04 Recite number names from a given number to a stated number (forward 1 to 10, backward 10 to 1) using visual aids.

**N02** Students will be expected to recognize, at a glance, and name the quantity represented by familiar arrangements of one to five objects or dots. [C, CN, ME, V]

**Performance Indicators**

N02.01 Look briefly at a given familiar arrangement of one to five objects or dots and identify the number represented without counting.
N02.02 Identify the number represented by a given dot arrangement on a five-frame.

**N03** Students will be expected to relate a numeral, 1 to 10, to its respective quantity. [CN, R, V]

**Performance Indicators**

N03.01 Name the number for a given set of objects.
N03.02 Match numerals with their given pictorial representations.
N03.03 Hold up the appropriate number of fingers for a given numeral.
N03.04 Construct a set of objects corresponding to a given numeral.
N03.05 Record the numeral that represents the quantity of a given set of objects.

**N04** Students will be expected to represent and partition numbers 2 to 10 in two parts, concretely and pictorially. [C, CN, ME, R, V]

**Performance Indicators**

N04.01 Show a given number as two parts (using fingers, counters, or other objects) and name the number of objects in each part.

N04.02 Show a given number as two parts, using pictures, and name the number of objects in each part.

**N05** Students will be expected to compare sets containing 1 to 10 objects, using one-to-one correspondence.
[C, CN, V]

**Performance Indicators**

N05.01 Construct a set to show more than, fewer than, or as many as a given set.

N05.02 Compare two given sets through direct comparison and describe the sets using words such as *more*, *fewer*, *as many as*, or *the same number as*.

**N06** Students will be expected to demonstrate an understanding of counting to 10.
[C, CN, ME, PS, R, V]

**Performance Indicators**

N06.01 Answer the question, How many are in the set? using the last number counted in a set.

N06.02 In a fixed arrangement, starting in different locations, show that the count of the number of objects in a set does not change.

N06.03 Count the number of objects in a given set, rearrange the objects, predict the new count, and recount to verify the prediction.

## PATTERNS AND RELATIONS (PR)

**PR01** Students will be expected to demonstrate an understanding of repeating patterns (two or three elements) by identifying, describing, reproducing, extending, and creating patterns using manipulatives, sounds, and actions. [C, CN, PS, V]

**Performance Indicators**

PR01.01 Distinguish between repeating patterns and non-repeating sequences in a given set by identifying the part that repeats.

PR01.02 Reproduce a given repeating pattern and describe the pattern.

PR01.03 Extend a variety of given repeating patterns to two more repetitions.

PR01.04 Create a repeating pattern using manipulatives, musical instruments, or actions, and describe the pattern.

PR01.05 Identify and describe a repeating pattern containing two or three elements in its core in the classroom, the school, and outdoors.

## Measurement (M)

**M01** Students will be expected to use direct comparison to compare two objects based on a single attribute, such as length, mass, volume, and capacity. [C, CN, PS, R, V]

**Performance Indicators**

M01.01 Compare the length of two given objects and explain the comparison using words such as *shorter*, *longer*, *taller*, or *almost the same*.
M01.02 Compare the mass of two given objects and explain the comparison using words such as *lighter*, *heavier*, or *almost the same*.
M01.03 Compare the capacity of two given objects and explain the comparison using words such as *holds less*, *holds more*, or *holds almost the same*.
M01.04 Compare the volume of two given objects and explain the comparison using words such as *bigger*, *smaller*, or *almost the same*.

## Geometry (G)

**G01** Students will be expected to sort 3-D objects using one attribute. [C, CN, PS, R, V]

**Performance Indicators**

G01.01 Sort a given set of familiar 3-D objects using one attribute, such as size or shape, and explain the sorting rule.
G01.02 Explain the sorting rule used to sort a pre-sorted set.

**G02** Students will be expected to build and describe 3-D objects. [CN, PS, V]

**Performance Indicators**

G02.01 Create a representation of a given 3-D object using building blocks and compare the representation to the original 3-D object.
G02.02 Describe a given 3-D object using words such as *big*, *little*, *round*, *like a box*, or *like a can*.

# Mathematical Processes

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and encourage lifelong learning in mathematics.

Students are expected to
- communicate in order to learn and express their understanding of mathematics (Communication [C])
- develop and apply new mathematical knowledge through problem solving (Problem Solving [PS])
- connect mathematical ideas to other concepts in mathematics, to everyday experiences, and to other disciplines (Connections [CN])
- demonstrate fluency with mental mathematics and estimation (Mental Mathematics and Estimation [ME])
- select and use technologies as tools for learning and solving problems (Technology [T])
- develop visualization skills to assist in processing information, making connections, and solving problems (Visualization [V])
- develop mathematical reasoning (Reasoning [R])

The Nova Scotia curriculum incorporates these seven interrelated mathematical processes that are intended to permeate teaching and learning. The key to these process standards is presented in a box, as shown below, with each specific curriculum outcome within the strands.

**Process Standards Key**

| | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

## Communication [C]

Students need opportunities to read about, represent, view, write about, listen to, and discuss mathematical ideas. These opportunities allow students to create links between their own language and ideas, and the formal language and symbols of mathematics. Communication is important in clarifying, reinforcing, and modifying ideas, knowledge, attitudes, and beliefs about mathematics. Students should be encouraged to use a variety of forms of communication while learning mathematics.

Students also need to communicate their learning using mathematical terminology. Communication can help students make connections between and among the different representational modes—contextual, concrete, pictorial, linguistic/verbal, and symbolic—of mathematical ideas. Students must communicate *daily* about their mathematics learning. This enables them to reflect, to validate, and to clarify their thinking and provides teachers with insight into students' interpretations of mathematical meanings and ideas.

## Problem Solving [PS]

Learning through problem solving should be the focus of mathematics at all grade levels. When students encounter new situations and respond to questions of the type, How would you ...? or How could you ...? the problem-solving approach is being modelled. Students develop their own problem-solving strategies by being open to listening, discussing, and trying different strategies.

In order for an activity to be problem-solving based, it must ask students to determine a way to get from what is known to what is sought. If students have already been given ways to solve the problem, it is not a problem, but practice. A true problem requires students to use prior learning in new ways and contexts. Problem solving requires and builds depth of conceptual understanding and student engagement, perseverance, and collaboration.

Problem solving is also a powerful teaching tool that fosters multiple, creative, and innovative solutions. Creating an environment where students openly look for and engage in finding a variety of strategies for solving problems empowers students to explore alternatives and develops confident, cognitive, mathematical risk takers.

When students are exposed to a wide variety of problems in all areas of mathematics, they explore various methods for solving and verifying problems. In addition, they are challenged to find multiple solutions for problems and to create their own problem.

## Connections [CN]

Contextualization and making connections to the experiences of learners are powerful processes in developing mathematical understanding. When mathematical ideas are connected to one another or to real-world phenomena, students can begin to view mathematics as useful, relevant, and integrated. Learning mathematics within contexts and making connections relevant to learners can validate past experiences and increase student willingness to participate and be actively engaged. The brain is constantly looking for and making connections.

"Because the learner is constantly searching for connections on many levels, educators need to *orchestrate the experiences* from which learners extract understanding. … *Brain research establishes and confirms that multiple complex and concrete experiences are essential for meaningful learning and teaching*." (Caine and Caine 1991, p. 5).

Mathematics should be viewed as an integrated whole rather than as the study of separate strands or units. Connections must also be made between and among the different representational modes—contextual, concrete, pictorial, linguistic/verbal, and symbolic. The process of making connections, in turn, facilitates learning. Concepts and skills should also be connected to everyday situations and other curricular areas. For example, when developing literacy skills students learn to make text-to-world, text-to-text, and text-to-self connections. Students can also make connections to make mathematics come alive through math-to-world, math-to-math, and math-to-self connections.

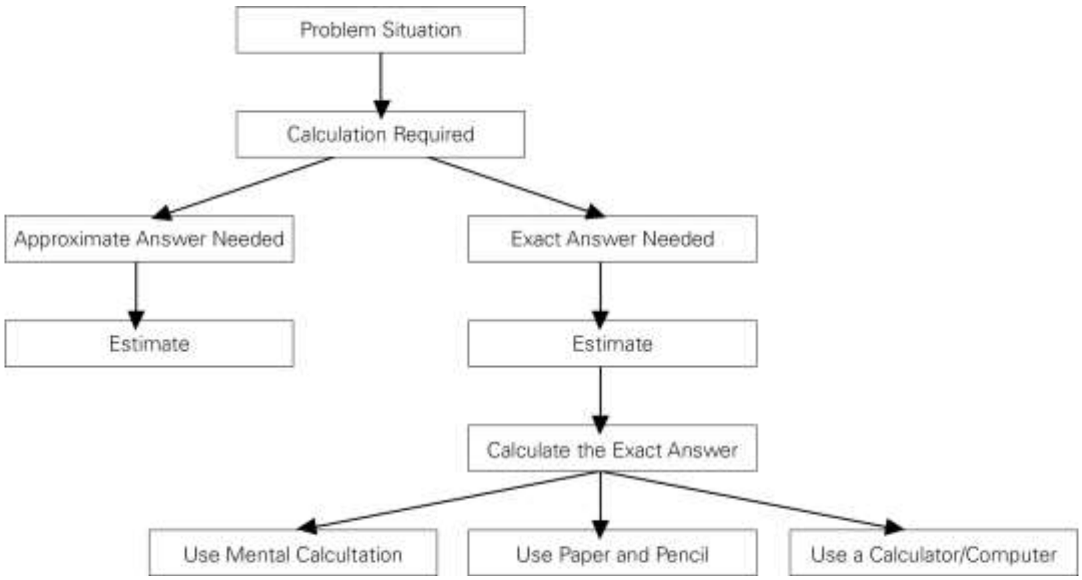
## Mental Mathematics and Estimation [ME]

Mental mathematics is a combination of cognitive strategies that enhance flexible thinking and number sense. It is calculating mentally without the use of external aids. Mental mathematics enables students to determine answers without paper and pencil. It improves computational fluency by developing efficiency, accuracy, and flexibility. "Even more important than performing computational procedures or using calculators is the greater facility that students need—more than ever before—with estimation and mental math." (National Council of Teachers of Mathematics, May 2005).

Students proficient with mental mathematics "become liberated from calculator dependence, build confidence in doing mathematics, become more flexible thinkers, and are more able to use multiple approaches to problem solving." (Rubenstein 2001) Mental mathematics "provides a cornerstone for all estimation processes, offering a variety of alternative algorithms and nonstandard techniques for finding answers." (Hope 1988, v)

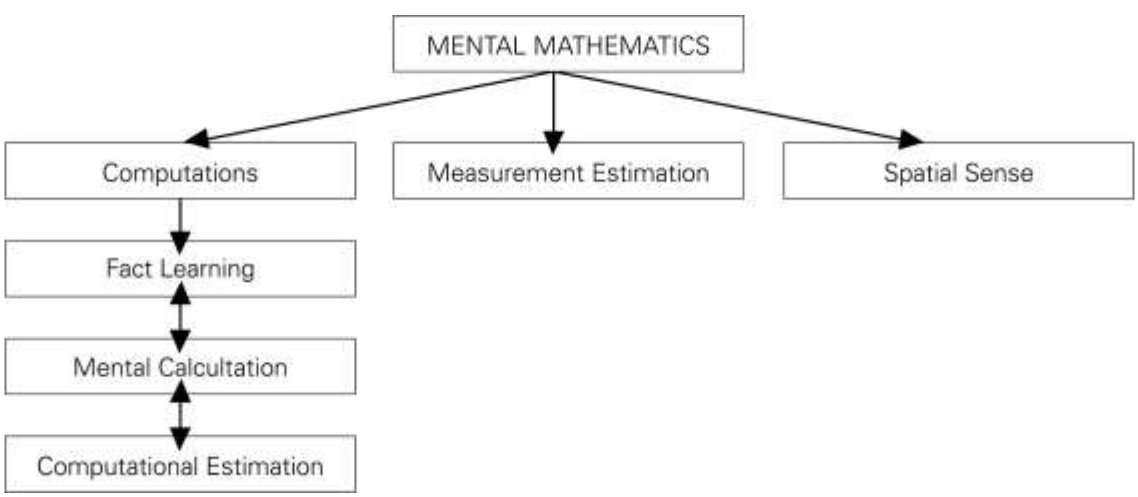
Estimation is a strategy for determining approximate values or quantities, usually by referring to benchmarks or using referents, or for determining the reasonableness of calculated values. Students need to know how, when, and what strategy to use when estimating. Estimation is used to make mathematical judgments and develop useful, efficient strategies for dealing with situations in daily life.

Students need to develop both mental mathematics and estimation skills through context and not in isolation so they are able to apply them to solve problems. Whenever a problem requires a calculation, students should follow the decision-making process as illustrated on the following page.




The skill of estimation requires a sound knowledge of mental mathematics. Both are necessary to many everyday experiences, and students should be provided with frequent opportunities to practise these skills.

For the purpose of this document and to provide some uniformity in communication, it is important that some mental mathematics terms are defined. Nova Scotia uses the term mental mathematics to encompass the whole range of mental processing of information in all strands of the curriculum. This mental mathematics is broken into three categories in this document: computations, measurement estimation, and spatial sense. Computations are further broken down into fact learning, mental calculations, and computational estimation.



## FACT Learning

*Fact learning* refers to the acquisition of the 100 number facts related to the single digits 0 to 9 for each of the four operations, addition, subtraction, multiplication, and division. When students know these facts, they can quickly retrieve them from memory (usually in three- to five- seconds). Ideally, through practice over time, students will achieve automaticity; that is, they will have instant recall without using strategies. *Mental calculation* refers to getting exact answers by using strategies to do the calculations in one's head, while *computational estimation* refers to getting approximate answers by using strategies to do calculations in one's head.

While each category in computations has been defined separately, this does not suggest that the three categories are entirely separable. Initially, students develop and use strategies to get quick recall of the facts. These strategies and the facts themselves are the foundations for the development of other mental calculation strategies. When the facts are automatic, students are no longer employing strategies to retrieve them from memory. In turn, the facts and mental calculation strategies are the foundations for computational estimation strategies. Actually, attempts at computational estimation are often thwarted by the lack of knowledge of the related facts and mental calculation strategies.

*Measurement estimation* is the process of using internal and external visual (or tactile) information to get approximate measures, or to make comparisons of measures, without the use of measurement instruments.

*Spatial sense* is an intuition about shapes and their relationships, and an ability to manipulate shapes in one's mind. It includes being comfortable with geometric descriptions of shapes and positions.

While there is no mandated time allotted for mental mathematics in Mathematics Primary, students need to develop some important concepts about number to prepare them for mental mathematics learning in Mathematics 1. These concepts include

- counting
  - rote counting – saying the number names in order
  - meaningful counting – determining quantity
- representing numbers
- partitioning numbers (part-part-whole)
- spatial relationships and subitizing (recognize at a glance a quantity of objects without counting)
- comparing numbers
  - more than
  - the same as
  - fewer than
- benchmarks and referents - anchors to 5 and 10

Throughout the year, students should be working toward developing these very important concepts using dot cards, dot cubes, dot plates, five-frames, ten-frames, and number cubes.

## Technology [T]

Technology can be effectively used to contribute to and support the learning of a wide range of mathematical outcomes and enables students to explore and create patterns, examine relationships, test conjectures, and solve problems. Information and communication technology best improves learning when it is accessible, flexible, responsive, participatory, and integrated thoroughly into all public school programs.

Technology can be used to
- explore and demonstrate mathematical relationships and patterns
- organize and display data
- extrapolate and interpolate
- assist with calculation procedures as part of solving problems
- decrease the time spent on computations when other mathematical learning is the focus
- reinforce the learning of basic facts and test properties
- develop personal procedures for mathematical operations
- create geometric displays
- simulate situations
- develop number sense

The use of calculators is recommended to enhance problem solving, to encourage discovery of number patterns, and to reinforce conceptual development and numerical relationships. They do not, however, replace the development of number concepts and skills. Carefully chosen computer software can provide interesting problem-solving situations and applications.

Technology contributes to a learning environment in which the growing curiosity of students can lead to rich mathematical discoveries at all grade levels. While technology can be used in grades primary–6 to enrich learning, it is expected that students will achieve all outcomes without the use of technology, unless the use of technology is specified in the outcome.

*The Integration of Information and Communication Technology Within the Curriculum*, (Revision 2014) (P–6) can be found online in several locations including: http://lrt.ednet.ns.ca.

## Visualization [V]

Visualization "involves thinking in pictures and images, and the ability to perceive, transform and recreate different aspects of the visual-spatial world." (Armstrong 1999). The use of visualization in the study of mathematics provides students with opportunities to understand mathematical concepts and make connections among them. Visual images and visual reasoning are important components of number, spatial, and measurement sense. Number visualization occurs when students create mental representations of numbers. These mental images are needed to develop concepts and understand procedures. Images and explanations help students clarify their understanding of mathematical ideas in all strands.

Being able to create, interpret, and describe a visual representation is part of spatial sense and spatial reasoning. Spatial visualization and reasoning enable students to describe the relationships among and between 3-D objects and 2-D shapes.

Measurement visualization goes beyond the acquisition of specific measurement skills. Measurement sense includes the ability to determine when to measure, when to estimate and to know several estimation strategies. (Shaw and Cliatt 1989)

Visualization is fostered through the use of concrete materials, technology, and a variety of visual representations.

## Reasoning [R]

Mathematical reasoning helps students think logically and make sense of mathematics. Students need to develop confidence in their abilities to reason and justify their mathematical thinking. High-order questions challenge students to think and develop a sense of wonder about mathematics. Mathematical experiences in and out of the classroom provide opportunities for inductive and deductive reasoning. Inductive reasoning occurs when students explore and record results, analyze observations, make generalizations from patterns, and test these generalizations. Deductive reasoning occurs when students reach new conclusions based upon what is already known or assumed to be true.

Mathematics reasoning involves informal thinking, conjecturing, and validating—these help students understand that mathematics makes sense. Students are encouraged to justify, in a variety of ways, their solutions, thinking processes, and hypotheses. In fact, good reasoning is as important as finding correct answers.

# Nature of Mathematics

Mathematics is one way of trying to understand, interpret, and describe our world. There are a number of components that define the nature of mathematics, and these are woven throughout this document. These components include change, constancy, number sense, relationships, patterns, spatial sense, and uncertainty.

## Change

It is important for students to understand that mathematics is dynamic and not static. As a result, recognizing change is a key component in understanding and developing mathematics. Within mathematics, students encounter conditions of change and are required to search for explanations of that change. To make predictions, students need to describe and quantify their observations, look for patterns, and describe those quantities that remain fixed and those that change. For example, the sequence 4, 6, 8, 10, 12, … can be described as

- skip counting by 2s, starting from 4
- an arithmetic sequence, with first term 4 and a common difference of 2
- a linear function with a discrete domain

(Steen 1990, 184).

## Constancy

Different aspects of constancy are described by the terms **stability**, **conservation**, **equilibrium**, **steady state**, and **symmetry** (AAAS–Benchmarks 1993, 270). Many important properties in mathematics and science relate to properties that do not change when outside conditions change. Some problems in mathematics require students to focus on properties that remain constant. The recognition of constancy enables students to solve problems. Examples of constancy include the following:

- The area of a rectangular region is the same regardless of the methods used to determine the solution.
- The sum of the interior angles of any triangle is 180°.
- The theoretical probability of flipping a coin and getting heads is 0.5.

## Number Sense

Number sense, which can be thought of as intuition about numbers, is the most important foundation of numeracy (British Columbia Ministry of Education 2000, 146). A true sense of number goes well beyond the skills of simply counting, memorizing facts, and the situational rote use of algorithms. Number sense develops when students connect numbers to real-life experiences and use benchmarks and referents. This results in students who are computationally fluent, flexible with numbers, and have intuition about numbers. The evolving number sense typically comes as a by-product of learning rather than through direct instruction. However, number sense can be developed by providing rich mathematical tasks that allow students to make connections.

## Relationships

Mathematics is used to describe and explain relationships. As part of the study of mathematics, students look for relationships among numbers, sets, shapes, objects, and concepts. The search for possible relationships involves the collection and analysis of data, and describing relationships visually, symbolically, orally, or in written form.

## Patterns

Mathematics is about recognizing, describing, and working with numerical and non-numerical patterns. Patterns exist in all strands, and it is important that connections are made among strands. Working with patterns enables students to make connections within and beyond mathematics. These skills contribute to students' interaction with an understanding of their environment. Patterns may be represented in concrete, visual, or symbolic form. Students should develop fluency in moving from one representation to another. Students must learn to recognize, extend, create, and use mathematical patterns. Patterns allow students to make predictions and justify their reasoning when solving problems. Learning to work with patterns in the early grades helps develop students' algebraic thinking, which is foundational for working with more abstract mathematics in higher grades.

## Spatial Sense

Spatial sense involves visualization, mental imagery, and spatial reasoning. These skills are central to the understanding of mathematics. Spatial sense enables students to reason and interpret among and between 3-D and 2-D representations and identify relationships to mathematical strands. Spatial sense is developed through a variety of experiences and interactions within the environment. The development of spatial sense enables students to solve problems involving 3-D objects and 2-D shapes. Spatial sense offers a way to interpret and reflect on the physical environment and its 3-D or 2-D representations. Some problems involve attaching numerals and appropriate units (measurement) to dimensions of objects. Spatial sense allows students to make predictions about the results of changing these dimensions. For example,

- knowing the dimensions of an object enables students to communicate about the object and create representations
- the volume of a rectangular solid can be calculated from given dimensions
- doubling the length of the side of a square increases the area by a factor of four

## Uncertainty

In mathematics, interpretations of data and the predictions made from data may lack certainty. Events and experiments generate statistical data that can be used to make predictions. It is important to recognize that these predictions (interpolations and extrapolations) are based upon patterns that have a degree of uncertainty. The quality of the interpretation is directly related to the quality of the data. An awareness of uncertainty allows students to assess the reliability of data and data interpretation. Chance addresses the predictability of the occurrence of an outcome. As students develop their understanding of probability, the language of mathematics becomes more specific and describes the degree of uncertainty more accurately.

# Curriculum Document Format

This curriculum document presents the mathematics curriculum so that a teacher may readily view the scope of the outcomes that students are expected to achieve during that year. Teachers are encouraged, however, to examine what comes before and what follows after, to better understand how students' learning at a particular grade level is part of a bigger picture of concept and skill development.

The order of presentation in no way assumes or prescribes a preferred order of presentation in the classroom, but simply lays out the specific curriculum outcomes in relation to the overarching general curriculum outcomes (GCOs).

The footer of the document shows the name of the course, and the strand name is presented in the header. When a specific curriculum outcome (SCO) is introduced, it is followed by the mathematical processes and performance indicators for that outcome. A scope and sequence is then provided, which relates the SCO to previous and next grade SCOs. Also, for each SCO, there is background information, assessment strategies, suggested instructional strategies, suggested models and manipulatives, mathematical language, and a section for resources and notes. For each section, the guiding questions should be used to help with unit and lesson preparation.

**Specific Curriculum Outcome (SCO)**

| Mathematical Processes | | |
|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections |
| **[ME]** Mental Mathematics and Estimation | | |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning |

**Performance Indicators**

Describes observable indicators of whether students have achieved the specific outcome.

**Scope and Sequence**

| | | |
|---|---|---|
| Previous grade or course SCOs | Current grade SCO | Following grade or course SCOs |

**Background**

Describes the “big ideas” to be learned and how they relate to work in previous grade and work in subsequent courses.

**Performance Indicator Background**

Contains further elaborations for the performance indicators.

## Assessment, Teaching, and Learning

**Assessment Strategies**

**Guiding Questions**
- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

**ASSESSING PRIOR KNOWLEDGE**

Sample tasks that can be used to determine students’ prior knowledge.

**WHOLE-CLASS/GROUP/INDIVIDUAL ASSESSMENT TASKS**

Some suggestions for specific activities and questions that can be used for both instruction and assessment

**FOLLOW-UP ON ASSESSMENT**

**Guiding Questions**
- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

**RESPONDING TO ASSESSMENT**

Correlations to related resources.

**Planning for Instruction**

**Guiding Questions**
- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcome and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

**CHOOSING INSTRUCTIONAL STRATEGIES**

Suggested strategies for planning daily lessons.

**SUGGESTED LEARNING TASKS**

Suggestions for general approaches and strategies suggested for teaching this outcome.

**Guiding Questions**
- How can the scope and sequence be used to determine what prior knowledge needs to be activated prior to beginning new instruction?

**SUGGESTED MODELS AND MANIPULATIVES**

**MATHEMATICAL LANGUAGE**

Teacher and student mathematical language associated with the respective outcome.

## Resources/Notes

# Contexts for Learning and Teaching

## Beliefs about Students and Mathematics Learning

“Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.” (National Council of Teachers of Mathematics 2000, 20).

The Nova Scotia mathematics curriculum is based upon several key assumptions or beliefs about mathematics learning that have grown out of research and practice. These beliefs include the following:

- Mathematics learning is an active and constructive process.
- Learning is most effective when standards of expectation are made clear with ongoing assessment and feedback.
- Learners are individuals who bring a wide range of prior knowledge and experiences and who learn via various styles and at different rates.
- Learning is most likely to occur when placed in meaningful contexts and in an environment that supports exploration, risk taking, and critical thinking and that nurtures positive attitudes and sustained effort.

Children are curious, active learners with individual interests, abilities, and needs. They come to classrooms with varying knowledge, life experiences, and backgrounds. A key component in successfully developing numeracy is making connections to these backgrounds and experiences.

Students develop a variety of mathematical ideas before they enter school. Children make sense of their environment through observations and interactions at home and in the community. Mathematics learning is embedded in everyday activities, such as playing, reading, storytelling, and helping around the home. Such activities can contribute to the development of number and spatial sense in children. Curiosity about mathematics is fostered when children are engaged in activities such as comparing quantities, searching for patterns, sorting objects, ordering objects, creating designs, building with blocks, and talking about these activities. Positive early experiences in mathematics are as critical to child development as are early literacy experiences.

Students learn by attaching meaning to what they do and need to construct their own meaning of mathematics. This meaning is best constructed when learners encounter mathematical experiences that proceed from the simple to the complex and from the concrete to the abstract. The use of models and a variety of pedagogical approaches can address the diversity of learning styles and developmental stages of students and enhance the formation of sound, transferable, mathematical concepts. At all levels, students benefit from working with and translating through a variety of materials, tools, and contexts when constructing meaning about new mathematical ideas. Meaningful discussions can provide essential links among concrete, pictorial, contextual, and symbolic representations of mathematics.

The learning environment should value and respect all students’ experiences and ways of thinking, so that learners are comfortable taking intellectual risks, asking questions, and posing conjectures. Students need to explore problem-solving situations in order to develop personal strategies and become mathematically literate. Learners must realize that it is acceptable to solve problems in different ways and that solutions may vary.

## Goals for Mathematics Education

The main goals of mathematics education are to prepare students to
- use mathematics confidently to solve problems
- communicate and reason mathematically
- appreciate and value mathematics
- make connections between mathematics and its applications
- become mathematically literate adults, using mathematics to contribute to society

Students who have met these goals will
- gain understanding and appreciation of the contributions of mathematics as a science, a philosophy, and an art
- exhibit a positive attitude toward mathematics
- engage and persevere in mathematical tasks and projects
- contribute to mathematical discussions
- take risks in performing mathematical tasks
- exhibit curiosity about mathematics and situations involving mathematics

## Opportunities for Success

A positive attitude has a profound effect on learning. Environments that create a sense of belonging, encourage risk taking, and provide opportunities for student success help develop and maintain positive attitudes and self-confidence. Students with positive attitudes toward learning mathematics are likely to be motivated and prepared to learn, participate willingly in classroom activities, persist in challenging situations, and engage in reflective practices.

To experience success, students must be taught to set achievable goals or assess their progress as they work toward these goals. Striving toward success and becoming autonomous and responsible learners are ongoing, reflective processes that involve revisiting the setting and assessing of personal goals.

## Engaging All Learners

"No matter how engagement is defined or which dimension is considered, research confirms this truism of education: *The more engaged you are, the more you will learn.*" (Hume 2011, 6)

Student engagement is at the core of learning. Engagement in learning occurs when students are provided with opportunities to become more invested in their learning. This is critical for teachers to take into account when planning and implementing instruction. Effective instruction engages, embraces, and supports all learners through a range of learning experiences that are both age and developmentally appropriate.

This curriculum is designed to provide learning opportunities that are equitable, accessible, and inclusive of the many facets of diversity represented in today's classrooms. When teachers know their students as individual learners and as individual people, their students are more likely to be motivated to learn, persist in challenging situations, and apply reflective practices.

## Supportive Learning Environments

A supportive and positive learning environment has a profound effect on students' learning. Students need to feel physically, socially, emotionally, and culturally safe in order to take risks with their learning. In classrooms where students feel a sense of belonging, see their teachers' passion for learning and teaching, are encouraged to actively participate, and are challenged appropriately, they are more likely to be successful.

Teachers recognize that not all students progress at the same pace nor are they equally positioned in terms of their prior knowledge of particular concepts, skills, and learning outcomes. Teachers are able to create more equitable access to learning when

- instruction and assessment are flexible and offer multiple means of representation
- students have options to engage in learning through multiple ways
- students can express their knowledge, skills, and understanding in multiple ways

(Hall, Meyer, and Rose 2012)

In a supportive learning environment, teachers plan learning experiences that support *each* student's ability to achieve curriculum outcomes. Teachers use a variety of effective instructional approaches that help students to succeed, such as

- providing a range of learning opportunities that build on individual strengths and prior knowledge
- providing all students with equitable access to appropriate learning strategies, resources, and technology
- involving students in the creation of criteria for assessment and evaluation
- engaging and challenging students through inquiry-based practices
- verbalizing their own thinking to model comprehension strategies and new learning
- balancing individual, small-group, and whole-class learning experiences
- scaffolding instruction and assignments as needed and giving frequent and meaningful descriptive feedback throughout the learning process
- integrating "blended learning" opportunities by including an online environment that extends learning beyond the physical classroom
- encouraging students to take time and to persevere, when appropriate, in order to achieve a particular learning outcome

## Multiple Ways of Learning

"Advances in neuroscience and education research over the past 40 years have reshaped our understanding of the learning brain. One of the clearest and most important revelations stemming from brain research is that there is no such thing as a 'regular student.'" (Hall, Meyer, and Rose 2012, 2) Teachers who know their students well are aware of students' individual learning differences and use this understanding to inform instruction and assessment decisions.

The ways in which students make sense of and demonstrate learning vary widely. Individual students tend to have a natural inclination toward one or a few learning styles. Teachers are often able to detect learning strengths and styles through observation and through conversation with students. Teachers can also get a sense of learning styles through an awareness of students' personal interests and talents. Instruction and assessment practices that are designed to account for multiple learning styles create greater opportunities for all students to succeed.

While multiple learning styles are addressed in the classroom, the three most commonly identified are:

- auditory (such as listening to teacher-modelled think-aloud strategies or participating in peer discussion)
- kinesthetic (such as examining artifacts or problem-solving using tools or manipulatives)
- visual (such as reading print and visual texts or viewing video clips)

For additional information, refer to *Frames of Mind: The Theory of Multiple Intelligences* (Gardner 2007) and *How to Differentiate Instruction in Mixed-Ability Classrooms* (Tomlinson 2001).

### A Gender-Inclusive Curriculum and Classroom

It is important that the curriculum and classroom climate respect the experiences and values of all students and that learning resources and instructional practices are not gender-biased. Teachers promote gender equity and inclusion in their classrooms when they

- articulate equally high expectations for all students
- provide equal opportunity for input and response from all students
- model gender-fair language, inclusive practices, and respectful listening in their interactions with students
- identify and openly address societal biases with respect to gender and sexual identity

### Valuing Diversity: Teaching with Cultural Proficiency

"Instruction that is embedded in socially meaningful contexts, and tasks that are meaningful and relevant to the lives of students, will engage students in high-level problem-solving and reasoning and enhance students' engagement (Frankenstein 1995; Gutstein 2003; Ladson-Billings 1997; Tate 1995)." (Herzig 2005)

Teachers appreciate that students have diverse life and cultural experiences and that individual students bring different prior knowledge to their learning. Teachers can build upon their knowledge of their students as individuals, value their prior experiences, and respond by using a variety of culturally-proficient instruction and assessment practices in order to make learning more engaging, relevant, and accessible for all students. For additional information, refer to *Racial Equity Policy* (Nova Scotia Department of Education 2002) and *Racial Equity / Cultural Proficiency Framework* (Nova Scotia Department of Education 2011).

### Students with Language, Communication, and Learning Challenges

Today's classrooms include students who have diverse language backgrounds, abilities, levels of development, and learning challenges. By observing and interacting with students and by conversing with students and/or their families, teachers gain deeper insights into the student as a learner. Teachers can use this awareness to identify and respond to areas where students may need additional support to achieve their learning goals. For students who are experiencing difficulties, it is important that teachers distinguish between those students for whom curriculum content is challenging and those for whom language-based factors are at the root of apparent academic difficulties. Students who are learning English as an additional language may require individual support, particularly in language-based subject areas, while they become more proficient in their English language skills. Teachers understand that many students who appear to be disengaged may be experiencing difficult life or family circumstances, mental health challenges, or low self-esteem, resulting in a loss of confidence that affects their engagement in learning. A caring, supportive teacher demonstrates belief in the students' abilities to learn and uses the students' strengths to create small successes that help nurture engagement in learning and provide a sense of hope.

#### STUDENTS WHO DEMONSTRATE EXCEPTIONAL TALENTS AND GIFTEDNESS

Modern conceptions of giftedness recognize diversity, multiple forms of giftedness, and inclusivity. Some talents are easily observable in the classroom because they are already well developed and students have opportunities to express them in the curricular and extracurricular activities commonly offered in schools. Other talents only develop if students are exposed to many and various domains and hands-on experiences. Twenty-first century learning supports the thinking that most students are more engaged when learning activities are problem-centred, inquiry-based, and open-ended. Talented and gifted students usually thrive when such learning activities are present. Learning experiences may be enriched by offering a range of activities and resources that require increased cognitive demand and higher-level thinking with different degrees of complexity and abstraction. Teachers can provide further challenges and enhance learning by adjusting the pace of instruction and the breadth and depth of concepts being explored. For additional information, refer to *Gifted Education and Talent Development* (Nova Scotia Department of Education 2010).

## Connections across the Curriculum

The teacher should take advantage of the various opportunities available to integrate mathematics and other subjects. This integration not only serves to show students how mathematics is used in daily life, but it helps strengthen the students' understanding of mathematical concepts and provides them with opportunities to practise mathematical skills. There are many possibilities for integrating mathematics in health education, literacy, music, physical education, science, social studies, and visual arts.

# Number (N)

**GCO: Students will be expected to demonstrate number sense.**

| **SCO N01** Students will be expected to say the number sequence by<br>▪ 1s from 1 to 20<br>▪ 1s, starting anywhere from 1 to 10 and from 10 to 1<br>[C, CN, V] | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**N01.01** Recite the number sequence from 1 to 20 and from 10 to 1.
**N01.02** Name the number that comes after a given number, 1 to 9.
**N01.03** Name the number that comes before a given number, 2 to 10.
**N01.04** Recite number names from a given number to a stated number (forward 1 to 10, backward 10 to 1) using visual aids.

## Scope and Sequence

| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **N01** Students will be expected to say the number sequence by<br>▪ 1s from 1 to 20<br>▪ 1s, starting anywhere from 1 to 10 and from 10 to 1 | **N01** Students will be expected to say the number sequence by<br>▪ 1s, forward and backward between any two given numbers, 0 to 100<br>▪ 2s to 20, forward starting at 0<br>▪ 5s to 100, forward starting at 0, using a hundred chart or a number line<br>▪ 10s to 100, forward starting at 0, using a hundred chart or a number line<br>**N08** Students will be expected to identify the number, up to 20, that is one more, two more, one less, and two less than a given number. |

## Background

Meaningful counting involves an understanding of the six principles of counting. These principles are addressed in various outcomes (N01, N03, and N06). The principle in bold face is the one addressed in this outcome.

1. One number is said for each item in the group and is counted once and only once. (one-to-one correspondence)
2. **Counting begins with the number 1, and there is a set number sequence. (stable order)**
3. The quantity in the set is the last number said. (cardinality)
4. The starting point and order of counting the objects does not affect the quantity. (order irrelevance)
5. The arrangement or types of objects does not affect the count. (conservation)
6. It does not matter what is being counted, the resulting count will always be the same. (abstraction)

**Stable Order Principle:** In everyday use, there are two meanings of “to count.” One meaning is to say the numbers in order (outcome N01 addresses this meaning), which addresses the stable order principle. As early as two years of age, children can repeat words such as one, two, and three; however, children most likely do not understand the quantity represented by those numbers. Understanding quantity is the second meaning of “to count”. Outcomes N02, N03, and N06 address this second meaning.

Learning the number names is an important prerequisite for counting items in a set. “Before there can be any meaningful counting, students must be able to recite the sequence beginning 1, 2, 3, 4, 5, etc.” (Small 2009, 84). There is a difference between being able to recite the number words (1, 2, 3, ...) and understanding how counting is used to describe a set. The counting sequence itself is a rote procedure; however, “The meaning attached to counting is the key conceptual idea on which all other number concepts are developed.” (Van de Walle and Lovin 2006, 39).

This outcome should be addressed throughout the year, allowing for its different aspects to be addressed in appropriate developmental stages.

1. Saying the number sequence from 1 to 10 can be addressed first since this is an important prerequisite for counting items in a set. As such, this counting sequence should be integrated with SCO N03 and SCO N06 and expanded as students’ fluency with number names develops.
2. Naming the number that comes after or before a given number, and counting forward and backward from any number can be addressed once students are more comfortable saying the number sequence from 1 to 10.
3. Saying the sequence of numbers from 11 to 20 can be addressed once students are very comfortable with numbers from 1 to 10. (**Note:** In Mathematics Primary, students are expected only to recite number names from 11 to 20 and are not expected to develop quantity sense for these numbers.)

## Performance Indicator Background

**N01.01** During the course of daily tasks, students should have frequent practice saying the number sequence from 1 to 10. The objective is to ensure that students know the counting sequences from 1 to 10 and from 10 to 1 so well that they can independently recite the number sequences correctly without prompts.

Later in the year, students should be expected to extend the counting sequence **forward by 1s** to 20. Learning the sequence of number names from 11 to 20 is challenging for young students. They simply have to remember that after ten comes eleven, twelve, thirteen, and so on. Knowing these number names is conventional knowledge; therefore, it will take many and frequent reinforcement activities to solidify and sustain these names.

**N01.02 and N01.03** Spontaneously stating the number after or before a given number is an important step in the development of number sense in **Mathematics P**rimary and is critical for performance indicator N01.04. Start by asking students to state the number after a given number (e.g., state a number and the students chant the number that comes after it). It could develop into leading a rhythmic chant: “I say 6, and you say __; I say 3, and you say __; I say 9, and you say __”; etc. This same approach can be applied to practice the number that comes before a given number.

**N01.04** Students should also be able to recite the number names forward and backward between two given numbers. Starting and ending numbers should be in the range of 1 to 10. With daily experiences, students should become proficient at reciting forward and backward from any number, so much so that they are able to begin without any hesitation. If there is a delay, they may be counting internally from 1 or from 10 until they reach the starting number **and so are not yet proficient.**

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**
- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### Assessing Prior Knowledge

Tasks such as the following could be used to determine students' prior knowledge.

- Ask students to start at 1 and recite the number sequence forward as far as they can.
- Ask students to recite the number sequence backward from 10 to 1.

### Whole-Class/Group/Individual Assessment Tasks

Consider the following **sample tasks** (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative).

- As students recite number sequences, do they
  - start at 1 and say the number names in order to 20
  - start at 10 and say the number names in order to 1
  - miss or skip any numbers in the sequence
  - recognize situations **in which** they recite the number sequence
  - identify the number that comes before a given number without needing to count back from 10
  - identify the number that comes after a given number without need to count up from 1
  - recognize and correct errors in a stated number sequence
- Ask students to start at 1 and recite the number sequence forward as far as they can.
- Ask students to say the number sequence backward from 10 to 1.
- Ask students to begin at 1 and say the number sequence to 20.
- Ask students to begin at 10 and say the number sequence to 1.
- Say a number sequence (1 to 20 or from 10 to 1) incorrectly and ask students to identify your error and correct it.
- Begin reciting the numbers from 1 to 20 or from 10 to 1, but omit some numbers. Ask students to tell you the numbers that are missing.
- Ask students to begin saying the number sequence at a given number and continue up to 10 (e.g., ask students to begin at 4 and count to 10. The student should continue by saying, 5, 6, 7, 8, 9, 10).
- Ask students to recite numbers backward by 1s starting at a given number (10 and less).
- Ask students to tell you what number comes after a given number and before a given number or between two numbers (e.g., after 8 and before 10).

### Follow-up on Assessment

**Guiding Questions**
- What conclusions can be made from assessment information?

- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

**RESPONDING TO ASSESSMENT**

*Numeracy Nets K–2* (Bauman 2011)
- No Checkpoint for this outcome.

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**
- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

**CHOOSING INSTRUCTIONAL STRATEGIES**

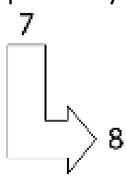
Consider the following strategies when planning daily lessons.

- During the course of daily tasks, ensure students have frequent opportunities to say the number sequence, forward and backward. For example,
  - count backward while taking items off a table or putting items away
  - countdown to special days
  - count while skipping, hopping, bouncing a ball, or taking part in other physical activities
  - count on while determining the total on a pair of number cubes
- Use children’s literature, such as counting songs, finger plays, and rhymes, to assist students in learning the number sequence.

**SUGGESTED LEARNING TASKS**

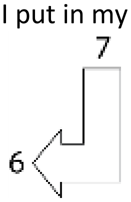
- Engage students in echo counting.The teacher recites a number sequence, and the students echo the teacher.
- Engage students in orchestra counting.Put students into groups. The first group begins reciting the number sequence forward from 1. When the teacher points to another group, they continue from the last number stated.
- Begin saying a number sequence from a given starting point less than 10, and ask students to continue up to the number 10. For example, say “3, 4, 5, …” This activity can be repeated by reversing the number sequence. For example, “5, 4, 3, …”
- Use poems, songs, and stories that have forward and backward counting sequences. Ask students to predict which number comes next as you read the poem or story.
- **I say… You say…:** Say a number and the class or individual student responds with the number that comes after or before the stated number.
- Make up riddles for numbers that come before and after a given number less than 10. For example, “I am three. What comes before me?” “I am four. What is one more?”

- Count some items with the students. Cover the starting quantity of items. Have the students count on as you add more items (up to 10).
- Show a dot card, five-frame, or ten-frame. Ask students to name the number shown and then to continue counting forward (or backward) from that number. Encourage students not to start at the beginning but to count forward (or backward) from the number being presented. Later, briefly show a dot card, five-frame, or ten-frame. Ask students to name the number that comes before (or after) the number shown.
- Draw a number machine on the board. It requires an input hopper and an output chute. Explain to students how the machine works; for example, This is a magic counting machine. It takes in a number up here and sends out the number that comes after it down here.
  Place a number or a dot card at the top of the machine. Ask students to tell the number or hold up the numeral card or the dot card that will be sent out the bottom of the machine.
  I put in my number.




The number that comes after 7 is 8.

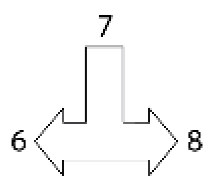
- Change the machine so that it shows the number that comes before the given number.
  I put in my number.




The number that comes before 7 is 6.

- Change the machine so that it shows both the number that comes before and after the given number.
  I put in my number.

The number that come before 7 is 6.




The number that comes after 7 is 8.

## SUGGESTED MODELS AND MANIPULATIVES

- collections of classroom objects
- counters
- fingers
- students

## MATHEMATICAL LANGUAGE

| **Teacher** | **Student** (oral language) |
|---|---|
| ▪ count back<br>▪ count backward<br>▪ count forward<br>▪ count on<br>▪ counting numbers: one to twenty<br>▪ position words: after, before, between, , next | ▪ count back<br>▪ count backward<br>▪ count forward<br>▪ count on<br>▪ counting numbers: one to twenty<br>▪ position words: after, before, between, next |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2008), pp. 18–19, 83–84
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 17–20, 139–140
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 39–40

## Videos

- *Teaching Number: 0 to 9* (14:47 min) (ORIGO Education 2010) (**Note:** Zero is not addressed in Mathematics Primary.)
- *Teaching Number: Counting* (10:49 min.) (ORIGO Education 2010)

## Notes

| **SCO N02** Students will be expected to recognize, at a glance, and name the quantity represented by familiar arrangements of one to five objects or dots.<br>[C, CN, ME, V] | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**N02.01** Look briefly at a given familiar arrangement of one to five objects or dots and identify the number represented without counting.

**N02.02** Identify the number represented by a given dot arrangement on a five-frame.

## Scope and Sequence

| Mathematics Primary | Mathematics 1 |
|---|---|
| **N02** Students will be expected to recognize, at a glance, and name the quantity represented by familiar arrangements of one to five objects or dots. | **N02** Students will be expected to recognize, at a glance, and name the quantity represented by familiar arrangements of one to ten objects or dots. |

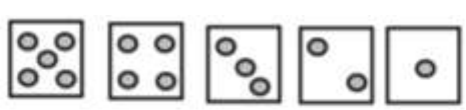
## Background

Cardinality refers to the quantity of objects in a set. The cardinality can be obtained by counting (SCO N03) or by subitizing. This outcome addresses subitizing. Subitizing is the ability to recognize, at a glance without one-to-one counting, a quantity of objects. For example, subitizing is the ability to immediately recognize the number of dots on a standard number cube when it is rolled, or to immediately recognize a number on a five-frame when it is presented briefly.

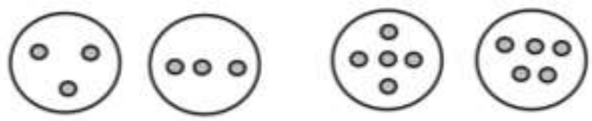
Research indicates that young students are able to subitize a quantity equal to their age; for example, a three-year old can subitize one to three objects. As such, most students subitize quantity before they learn to determine quantity by one-to-one counting. Students in Mathematics Primary should come to realize that subitizing and counting are two ways of determining how many are in a set of objects and not think that one-to-one counting is the only legitimate way to find how many.

Subitizing small arrangements of objects helps students with counting on, and composing and decomposing (partitioning) numbers. Initially, for some arrangements, some students may count the objects or dots, but by the end of Mathematics Primary, they must be able to recognize arrangements up to five dots or objects without counting. To avoid the misconception that an arrangement can only represent a specific quantity if it is arranged in a certain way, it is very important to vary the position of the objects, dots, or pictures.

**Number Cube Arrangements**



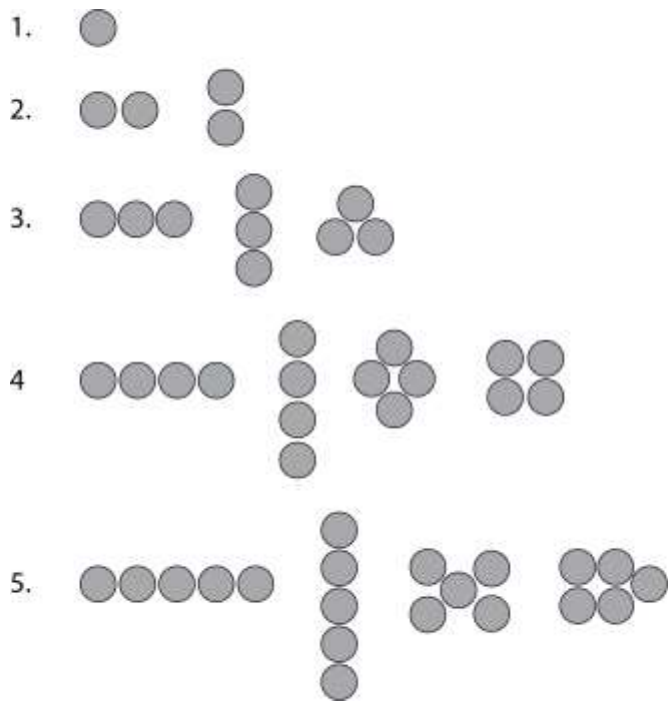
Examples of other familiar arrangements:



The two dot plates show 3. The two dot plates show 5.

## Performance Indicator Background

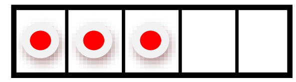
**N02.01** Students should recognize that there are many ways to arrange a set of objects and that some arrangements are easier to subitize than others. **They should also learn that, although the arrangements are different, the quantity in the set is the same.**




Most students are familiar with using their fingers to represent a number; therefore, this is a good representation with which to start. When asking students to identify the number of fingers being displayed, use different combinations of fingers so that students do not believe that there is only one way to represent the number. For example, any two fingers represent the quantity of 2; however, many students may think that only the middle and index fingers represent 2 because these two fingers are the only ones that have been used when they have heard or said “two.” For these students, 2 may be seen as a shape rather than a quantity.

When students begin learning the arrangements of dots up to 5, they should start with the arrangements found on a standard number cube. Once students have had experience with this set of arrangements, other arrangements can be introduced. For most numbers, there are several common or familiar arrangements, such as those found on dominoes or standard number cubes. These dot arrangements should be presented using paper plates, dot cards, as well as a standard number cube and dominoes. It is important to note that, as students are using a standard number cube, they may be able to subitize this familiar arrangement for 6 but would not be evaluated on it.

**N02.02** Students should be able to recognize, at a glance, any number up to 5 in a five-frame. A five-frame is a rectangle of five boxes with each box large enough to hold a counter. Five-frames focus on the relationship to five as an anchor for numbers. For example, this five-frame represents 3.



When using a five-frame, students should know that
- only one counter is permitted in each box of the five-frame
- counters are typically placed in the five-frame from the left to the right (the same way they read or write).

When subitizing, it is important to use the familiar (typical) arrangement; however, when students are creating their own representations of a number, other arrangements are acceptable. Once students have experience with five-frames and how each number is represented in a five-frame, they will be ready to work on subitizing them. Display for three seconds a number represented in a five-frame. Ask students to sketch or use stickers to show on an empty five-frame what they saw. Repeat using other numbers. Ask students to tell how many there are.

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**
- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### Assessing Prior Knowledge

Tasks such as the following could be used to determine students' prior knowledge.

- Use dot cards for 1, 2, and 3. Flash the cards in random order for 1 to 3 seconds each. (Do not give students time to count the dots.) After flashing each card, ask the students to tell you how many dots they saw.

### Whole-Class/Group/Individual Assessment Tasks

Consider the following **sample tasks** (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative).

- As students complete subitizing tasks, consider the following:
  - Are they able to recognize the number represented without counting?
  - Are they able to recognize the number when it is represented in a variety of ways?
  - Do they understand that there are many ways to arrange a set of objects?
  - Do they understand that although the arrangements are different, the quantity in the sets is the same?
  - Do they recognize that some arrangements are easier to recognize than others?
  - Do they recognize that patterns for larger numbers can be made up of two or more patterns for smaller numbers?

- Use your fingers to represent a quantity. Ask students to tell how many fingers you are holding up.
- Give each student five cards with the numerals 1 to 5 on them. Uncover a series of dots on the overhead projector, interactive whiteboard, or dot card and have students hold up the card with the correct corresponding numeral on it. This gives you a quick way of identifying who is able to subitize. Students may also respond orally.
- Hold up cards with arrangements of dots between 1 and 5 and ask, How many? Students may answer orally. Later in the year, they may write the corresponding numeral on a piece of paper and hold it up for you to see. (Note: The amount of time the card is shown to the student should not allow time for the student to count the dots.)
- Briefly hold up each five-frame for the numbers 1-5. The five-frames should be shown in random order. For each five-frame say, Here is a five-frame. How many dots did you see? (Note: The amount of time the five-frame is shown should not allow students the opportunity to count the dots.)Show three pie plate examples that display familiar arrangements of dots (two of the plates should display the same quantity of dots, but have different arrangements and the third should display a different quantity of dots). Ask students to identify (without counting) which plate shows the different quantity .
- Using coloured counters, ask students to show you three different arrangements that represent a particular number between 1 and 5.
- Ask students to roll a cube with dots and to tell you the number rolled without counting the dots.
- Ask students to show you on their individual five-frames a number that you announce to the class. Observe whether they have the correct number of corresponding dots (counters) placed on their five -frame
- Display for three seconds a number represented in a five-frame. Ask students to tell how many there are.
- Ask students to arrange 5 counters in a way that will make it easy to tell there are 5. Then, ask them to arrange 5 counters in a way that will make it difficult to tell there are 5.

#### FOLLOW-UP ON ASSESSMENT

**Guiding Questions**
- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

#### RESPONDING TO ASSESSMENT

*Numeracy Nets K–2* (Bauman 2011)
- Kindergarten Checkpoint 2, Task 2, pp. 30–31
- Kindergarten Checkpoint 4, pp. 47–48 (Line Masters 2.5 and 2.6)

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**
- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

### CHOOSING INSTRUCTIONAL STRATEGIES

Consider the following strategies when planning daily lessons.

- Provide opportunities for students to represent quantities in various arrangements.
- Encourage students to display numbers whenever possible, either with materials or by enacting the number physically (e.g., showing fingers, clapping).
- Expect students to explain, verbally, how they know how many are in a set.
- Use children's literature that shows a variety of arrangements for numbers.

### SUGGESTED LEARNING TASKS

- To introduce familiar arrangements, provide each student with about 10 counters and a piece of construction paper for a mat. Hold up a dot card for about 3 seconds. Ask, How many dots did you see? How did you see them? Then, ask students to make the same arrangement using the counters on the mat. Repeat this task with a new arrangement each day.
- Place counters on the glass of the overhead projector and cover them. Have students look at the screen. Uncover the counters for a few seconds only. Ask students to tell you how many counters they saw. Ask them to tell how they saw that number.
- Show a dot card for three seconds. Ask students to make the dot pattern they saw using counters.
- Show students a set of dot cards that all show the same number except for one card. Ask students to tell you which dot card does not belong in the set.
- Play a game of "concentration." Place pairs of dot cards face down in an array. Students take turns turning over two cards at a time, and if they match, they keep the pair. If the cards do not match, then the student returns the cards.
- Use dot cards or similar cards that show familiar arrangements of dots for numbers. Show students two cards at a time and ask students to tell you which card has more/less without counting.
- Use a five-frame, and ask students to identify the number of dots at a glance. Extend this activity to other models and arrangements, such as linking cubes.
- Display a five-frame, and after three seconds cover it. Ask students to place counters on an empty five-frame to copy what they saw. Repeat with different quantities.
- Invite students to explore arrangements of numbers. For example, students could create books in which each two-page spread shows a particular number of items, but in a different physical arrangement.
- Have students make a Rekenrek and complete subitizing activities with it.
- Give each student a set of numeral cards (0-10). Hold up a dot card for 1 to 3 seconds, and invite students to hold up the corresponding numeral card.
- Make a set of dot plates with various arrangements to represent numbers to 5. Briefly show a dot plate and ask students to use counters to make the number they saw. Later, ask students to tell the number of dots that they saw. Extend this by asking students to hold up rabbit ears to represent the number they saw. Later in the year, students can hold up a numeral card to indicate the number of dots they saw.

### SUGGESTED MODELS AND MANIPULATIVES

- counters
- dominoes
- dot cards
- fingers
- five-frames
- linking cubes
- number cubes
- Rekenrek

**MATHEMATICAL LANGUAGE**

| **Teacher** | **Student** (oral language) |
|---|---|
| ▪ dots, dot cards, dot arrangements<br>▪ five-frames, counters<br>▪ How many?<br>▪ sets<br>▪ subitize<br>▪ number names one to five | ▪ dots, dot cards<br>▪ five-frames, counters<br>▪ How many?<br>▪ number names one to five |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 89–91
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 145–148
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 43–44

## Video

- *Developing Sight Recognition of Quantity* (12:03 min.) (ORIGO Education 2010) (Subitizing)

## Notes

| **SCO N03** Students will be expected to relate a numeral, 1 to 10, to its respective quantity. [CN, R, V] | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**N03.01** Name the number for a given set of objects.
**N03.02** Match numerals with their given pictorial representations.
**N03.03** Hold up the appropriate number of fingers for a given numeral.
**N03.04** Construct a set of objects corresponding to a given numeral.
**N03.05** Record the numeral that represents the quantity of a given set of objects.

## Scope and Sequence

| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **N03** Students will be expected to relate a numeral, 1 to 10, to its respective quantity. | **N03** Students will be expected to demonstrate an understanding of counting to 20 by<br>▪ indicating that the last number said identifies “how many”<br>▪ showing that any set has only one count<br>▪ using the counting-on strategy |

## Background

Meaningful counting involves an understanding of the six principles of counting. These principles are addressed in various outcomes (N01, N02, N03, and N06). The principles in bold face are the ones addressed in this outcome.

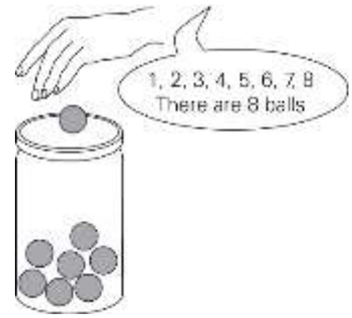
1. One number is said for each item in the group and is counted once and only once. (one-to-one correspondence)
2. Counting begins with the number 1, and there is a set number sequence. (stable order)
3. The quantity in the set is the last number said. (cardinality)
4. The starting point and order of counting the objects does not affect the quantity. (order irrelevance)
5. The arrangement or types of objects does not affect the count. (conservation)
6. It does not matter what is being counted, the resulting count will always be the same. (abstraction)

This outcome is connected to outcomes N02 and N06. All three outcomes relate to the quantity that results from one-to-one counting or from subitizing the objects in a set. As such, it is suggested that many lessons integrate these three outcomes. Outcomes N03 and N06 highlight a very critical counting principle (cardinality)—the last number said is the number (quantity) in the set, not the name of the last object touched.

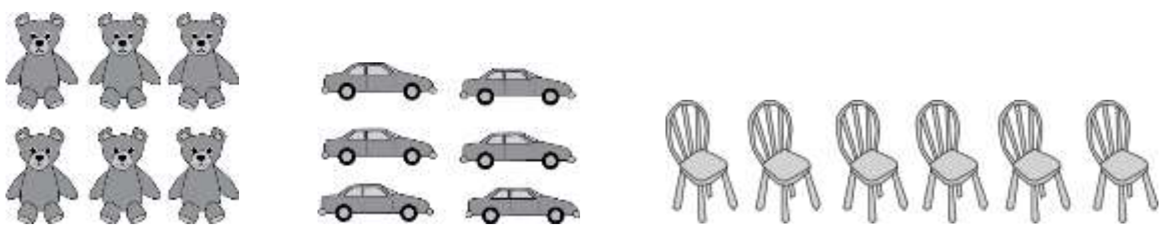
Before students count sets of a certain size, they should be fluent with the number sequence involved (the stable order principle addressed in outcome N01) so they can concentrate on the counting process rather than on trying to recall the number names. Set size should increase throughout the year as students’ knowledge of number names increases; for example, set size in quantity development can start with up to 3 objects once the numbers 1, 2, and 3 can be said by students fluently. Increase the set size as student development dictates.

**One-to-One Correspondence:** When students are counting, watch to see if they are touching objects while they count them and saying the appropriate numbers when they touch them. Encourage students to touch or move the objects as they count as this deepens their awareness of the one-to-one principle of counting.

**Cardinality:** Some students may very successfully perform a counting act of 8 objects, but when asked to show 8, pick up the last counter, thinking that this counter they touched when they said "eight" is 8, not the set of 8 counters. Help students develop this principle by engaging them in activities where objects are placed in a container as they are counted and directing students' attention to the number of objects in the container after the counting act.




**Abstraction Principle:** Students should understand that the size of the objects does not influence the number that represents the quantity in a set; that is, the objects themselves do not have to be uniform in size and shape, and two sets may both represent the same number even if the objects in one set are larger than those in the other. For example, students can count 6 bears, 6 toy cars, and 6 chairs. The three sets are equivalent because they all represent 6.



As well, many, if not most, of the sets of objects from 1 to 5 should eventually be identified at a glance (outcome N02). By the end of the year, one-to-one counting should be used for sets from 6 to 10 and for those sets from 3 to 5 that may not be in readily identified arrangements.

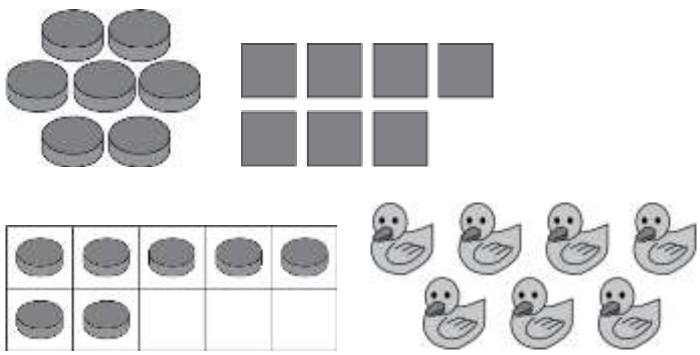
## Performance Indicator Background

**N03.01** When determining the number for a given set of objects, watch to see that students are using one-to-one correspondence. Listen to how the students are counting and verify that they start at 1 and say the number words in the correct sequence. Verify that students are realizing the last number said is the quantity of objects they have counted. Students should be able to demonstrate this on a variety of different sets of objects; therefore, a variety of materials should be used. Numbers from 1 to 10 should also be displayed in five- and ten-frames for students to name.

**N03.02** Students should experience counting and identifying the quantity of concrete objects before counting images printed on paper. Eventually students start relating the numeral (the symbolic representation of a number) to the number of objects in a set, presented pictorially. For example, students can be given a set of numeral cards and asked to hold up the appropriate card that represents a picture of a set of objects.

**N03.03** Students should be able to hold up the number of fingers that represent a given numeral being displayed. They should notice that different combinations of fingers can be used to represent the same numeral. For example, any six fingers can represent the numeral 6: 5 on one hand and 1 on the other, 4 on one hand and 2 on the other, or 3 on each hand.

**N03.04** Once students are able to determine the number of objects in a set, they should create sets of objects for given numbers. Initially, a number should be presented orally for students to create a set of that quantity. Once students are able to match numerals with quantities, they should create sets of objects that represent any given numeral. For example, students can show 7 in a variety of ways, such as those below.



**N03.05** This indicator is an extension of indicators N03.01 and N03.02 because students will be expected to not only name the number of objects and match it to its numeral, but also to record the appropriate numeral. Since it is important that students develop an efficient means of recording numerals, numeral writing should be taught as students are ready to record the appropriate numeral(s). Specific instruction and practise will be necessary. Integrating digit formation is an emergent writing opportunity that supports students in the development of writing skills. Initially, writing digits should not include the use of lined paper. Allow students to experiment freely on unlined paper using crayons and pencils or by using their fingers in a tray of sand. By the end of **Mathematics P**rimary, students should be introduced to writing numerals on lined paper.

Observe students as they write numerals, both when copying from a model and when forming them from memory. While there are other acceptable ways to form numerals, students should be encouraged to start at the top when printing numerals. Patterns in the formation of numerals could be highlighted as well. For example, **the numerals** 2, 3, and 7 start at the top and go to the right; **the numerals** 5, 6, 8, and 9 start at the top and go to the left; **and the numerals** 1 and 4 start at the top and go down. In these early years, it is not unusual for many students to reverse some of the digits as they write them. These students could be helped by getting them to compare the digits they write with ones you write, and by reminding them how to start making the digit. This practice should always be done in context.

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**

- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### ASSESSING PRIOR KNOWLEDGE

Tasks such as the following could be used to determine students' prior knowledge.

- Show students a set of 1 to 3 objects. Ask, How many objects are there? Observe whether the students are able to count the set of objects and name the number for the given set of objects or whether they are able to subitize the quantity Ask students to hold up fingers to match the number of objects on the table.

### WHOLE-CLASS/GROUP/INDIVIDUAL ASSESSMENT TASKS

Consider the following sample tasks (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative).

- Observe and note the way in which students count.
  - Do they start at 1 and say the number words in the correct sequence?
  - Do they realize the last number said is the quantity of objects they have counted?
  - Do they touch each object as they count?
  - Do they set items aside as they count them?
  - Do they show confidence in their count or feel the need to check?
  - Do they check their counting in the same order as the first count or in a different order?
- Ask students, How many fingers am I holding up? or ask students to hold up a given number of finger(s) that represent a given numeral being displayed.
- Give each student a five-frame or a ten-frame. Hold up a numeral card and ask students to show you that number on their five-frames or ten-frames. Observe whether they have the correct number of corresponding dots.
- Ask students to choose a numeral between 1 and 10 and create, and later draw, a set of objects that corresponds to that numeral. Repeat for several different numbers.
- Provide a variety of interesting photographs involving multiple people, animals, or objects. Ask students to tell how many are in the photographs and to record the corresponding numeral.
- Show students a numeral and ask them to clap that many times. For variation, clap and ask the students to point to the numeral that indicates the number of claps.
- Show a set of objects, dot cards, and five-frames or ten-frames. Ask students to name the number of objects shown and to record the numeral that matches the display.
- Fill paper bags with 10 different sized counters or objects (e.g., cubes, bear counters, erasers, crayons, large paper clips, etc.). In turn, students grab one handful of objects from each bag, count them, and record the number of items on a blank sheet of paper or index card.
- Give students sets of numeral cards from 1 to 10. Ask them to match the 10 numerals with corresponding sets of objects. Show sets of up to 10 items and ask them to hold up the corresponding numeral card. You can also hold up dot cards with the numbers from 1 to 10.

### FOLLOW-UP ON ASSESSMENT

**Guiding Questions**

- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

**RESPONDING TO ASSESSMENT**

*Numeracy Nets K–2* (Bauman 2011)

- Kindergarten Checkpoint 1, p. 21
- Kindergarten Checkpoint 2, Task 1, pp. 30–31 (Line Master 2.1)
- Kindergarten Checkpoint 15, pp. 139–140

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**

- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

**CHOOSING INSTRUCTIONAL STRATEGIES**

Consider the following strategies when planning daily lessons.

- Use a variety of physical materials that students can manipulate and group as they count. Number activities should use concrete objects prior to using printed images.
- Encourage students to use familiar and interesting objects to represent and model numbers whenever possible. Also, encourage students to enact numbers physically (e.g., showing fingers, clapping).
- Expect students to explain, verbally, how they know how many are in a set.
- Invite children to create sets of a given size using a variety of objects.
- Play a variety of games that use number cubes and counting.
- Work on writing numerals could begin by having students trace over numerals with their fingers. Later, students could make numerals in the air, before experimenting freely with writing numerals on unlined paper using markers, crayons, and pencils. By the end of Mathematics Primary, students should be introduced to writing numerals on lined paper.

**SUGGESTED LEARNING TASKS**

- Ask students to hold up the number of fingers that represent a given numeral.
- Give each student a ten-frame and 10 counters. On the ten-frame, have students show you different numbers from one to ten. You might say the number or write the numeral on the board and then have students display the number in the ten-frame. Repeat with different examples.
- Provide students with cards on which the numerals 1 to 10 are written. Make number arrangements on an overhead, using ten-frames and counters. Ask the students to select and show the numeral card that represents the arrangement. This activity can also be done with pairs of students.
- Ask students to create sets of objects that represent a given numeral. For example, ask students to show sets of 7 in a variety of ways using different objects.
- Play a concentration game with pairs of cards that show numerals and matching pictorial representations of counters, five-frames, ten-frames, dot cards, or dominoes.

- Sort the numerals in terms of characteristics; for example, those with rounded parts (like 8, 0), those with only straight parts (like 1, 7), and those with both (like 5, 2).
- Play “rabbit ears.” Students place their right hand beside their right ear and their left hand beside their left ear. Ask them to use their fingers to show the number that show them For example, a student may hold up 4 fingers on one hand and 3 fingers on the other hand to represent 7.
- Ask students to record numerals in the context of the activities above.
- Give each pair of students two decks of cards. One deck of cards has numerals from 1 to 5. The other deck of cards is a set of dot cards showing varied arrangements of 1 to 5 dots. Students place the set of dot cards face up on the table. Students take turns selecting a numeral card and then finding a dot card or all the dot cards that represent that number.

#### SUGGESTED MODELS AND MANIPULATIVES

- collections of objects
- counters
- dominoes
- dot cards
- five-frames and ten-frames
- number cubes

#### MATHEMATICAL LANGUAGE

| **Teacher** | **Student** (oral language) |
|---|---|
| ▪ numeral<br>▪ one-to-one counting<br>▪ quantity<br>▪ set of objects | ▪ numeral<br><br><br>▪ set of objects |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 88–91, pp. 93–94
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 144–148, 150–151
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 39–40

## Videos

- *Teaching Number: 0 to 9* (14:47 min.) (ORIGO Education 2010) (**Note:** Zero is not addressed in Mathematics Primary.)
- *Teaching Number: Counting* (10:49 min.) (ORIGO Education 2010)
- *Using a Hands-On Approach to Represent Numbers to 10* (13:06 min.) (ORIGO Education 2010)

## Notes

| **SCO N04** Students will be expected to represent and **partition numbers** 2 to 10 in two parts, concretely and pictorially.<br>[C, CN, ME, R, V] | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**N04.01** Show a given number as two parts (using fingers, counters, or other objects) and name the number of objects in each part.

**N04.02** Show a given number as two parts, using pictures, and name the number of objects in each part.

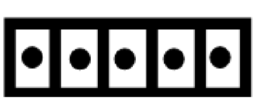
## Scope and Sequence

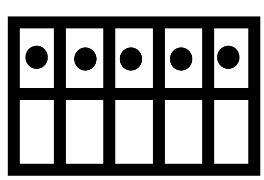
| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **N04** Students will be expected to represent and partition numbers 2 to 10 in two parts, concretely and pictorially. | **N04** Students will be expected to represent and partition numbers to 20. |

## Background

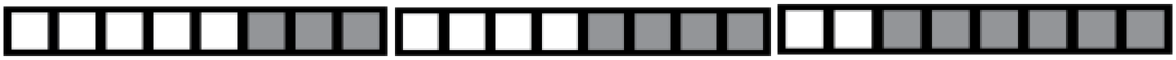
The ability to recognize that any number can be partitioned into two or more smaller numbers is an essential understanding in number development. Understanding the relationship between/among the parts and the whole is essential to developing a sense of numbers and an understanding of mathematical operations which will be introduced in Mathematics 1. It is important to understand that the action of partitioning a set of objects does not affect the count. (See counting principle 5 in outcome N06.) Students should be able to see small groups (parts) as part of a larger group (the whole). They should also be able to recognize how many objects are in each of the small groups (the parts) and how many objects are in the larger group (the whole). This helps students develop part-part-whole relationships.

Ten plays an important role in our number system and since five and five make ten, it is important for students to develop and understand the relationships between the numbers 1 to 10 and the important anchors of 5 and 10. Students should use five-frames and ten-frames to help them develop and learn about the important relationships of the parts of five and the parts of 10. Students will use five-frames and ten-frames to help them develop and learn about these anchors.





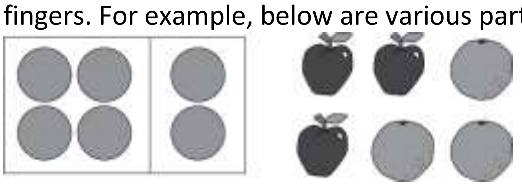
It is important to note that this important understanding of part-part-whole relationships is only introduced in Mathematics Primary by having students use concrete materials and pictures to show the two parts of a number up to 10. This will make sense to students if these materials and pictures represent real situations. For example, they could model the number of possible combinations of boys and girls in a group of 8 students by using counters or cubes of two different colours, and describe the different combinations that make 8. Most students in Mathematics Primary, however, will likely not be convinced that the whole remains the same regardless of how it is partitioned. This will be a focus of partitioning activities in Mathematics 1 and Mathematics 2. Below three partitions of 8 are shown using linking blocks.



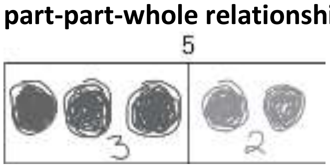
Counting a set of objects will not cause a child to focus on the fact that the set could be made up of two parts. This will require specific activities and questions that focus on a quantity in terms of its parts and the whole. Provide students with opportunities to demonstrate many ways of representing a number, both concretely and pictorially. Students need to talk about where and when they might use specific numbers and their parts. Representations may involve acting out situations, drawing, painting, or using concrete materials such as ten-frames. Students should then begin to use words to describe two parts of a number (five and five) and eventually record numerals to show the two parts (5 and 5). As with all mathematical concepts, opportunities for students to generate multiple representations of the same idea are a critical component of developing a deeper understanding.

## Performance Indicator Background

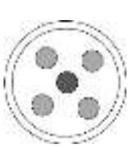
**N04.01** To conceptualize a number being made up of two or more parts is the most important relationship that can be developed about numbers, and it will take time for students to internalize this idea. The number 4 is a good place to start. It can be represented by raising 3 fingers on one hand and 1 finger on the other hand, or by raising 4 fingers on one hand and none on the other, or by 2 fingers on each hand. A student should also be able to name the parts of 4 by saying, “Four is three and one.” or “If four is the whole then this part is three and the other part is one.” A variety of representations and materials should be used to avoid the misconception that partitioning can only be represented using fingers. For example, below are various partitions of 6.



**N04.02** While using objects to represent part-part-whole relationships is a good beginning, students should also draw how they represent numbers in two parts using pictures. Eventually, they should also name the quantity in each part by recording the respective numeral beside or below each part and the whole. **Students in Mathematics Primary are not expected to record addition equations to represent part-part-whole relationships.**




The main strategy that students in Mathematics Primary will use as they construct part-part-whole relationships is counting. However, subitizing activities can and should be used to reinforce part-part-whole thinking. For example, if the 5- pattern on a standard number cube is represented with 4 red dots and 1 green dot on a paper plate, the students are asked, How many dots do you see? How many are red? How many are green?



# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**

- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### ASSESSING PRIOR KNOWLEDGE

Tasks such as the following could be used to determine students' prior knowledge.

- Show students dominoes representing numbers 2 to 4. Ask, How many dots are on each part of this domino? How many dots are there altogether?

### WHOLE-CLASS/GROUP/INDIVIDUAL ASSESSMENT TASKS

Consider the following **sample tasks** (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative).

- Hold up 3 fingers on one hand and 1 finger on the other hand. Ask students to name the parts by saying, "Four is three and one." or "If one part is 3 and the other part is 1, the whole is 4." Repeat using different combinations of fingers to represent 4.
- Shake and spill a handful of two different colours of counters (10 or less) on the overhead. Ask students to record (with pictures) how many of each colour there are and how many counters there are altogether. Eventually, they should also name the quantity in each part and in the whole by recording the respective numeral beside or below each part of their drawing.
- Give students sticker dots of two different colours and ask them to make different dot plates of numbers, using the two colours (e.g., They might show 8 dots, with 5 red and 3 yellow or 2 red and 6 yellow). Ask them to share with the class the different ways they represented the number in two parts.
- Provide students with a given number (10 or less) and ask them to make two-colour bars, using linking cubes (e.g., 5 blue and 3 red) to represent this number. Ask students to tell you about the number of cubes in each part and in the whole.
- Ask a student to count out 6 blocks/counters into your hand. Shake them up in both hands and then open hands to display a "6" combination, (e.g., 4 in one hand, 2 in the other). Ask students how many you have altogether. Repeat using different combinations. Observe whether or not students need to count. Ask students to each get 10 linking cubes—5 red, 3 green, and 2 yellow. Students can work in pairs to solve the following riddles.
  - I have 3 red cubes and 3 green cubes. How many cubes do I have?
  - I have 2 yellow cubes and the same number of red cubes. How many cubes do I have?
  - I have 8 cubes. There are 5 red cubes and the rest are green. How many cubes are green?
  - I built a tower of 7 cubes. The cubes are red and green. What could my tower look like? Which towers are the same? Which towers are different?

- Ask students to explore multiple ways to partition a number. For example, students could be asked to create books in which each page shows a different way to show the given number as two parts, using pictures. Students could be asked to record the number of objects in each part and in the whole.

#### FOLLOW-UP ON ASSESSMENT

**Guiding Questions**

- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

#### RESPONDING TO ASSESSMENT

*Numeracy Nets K–2* (Bauman 2011)

- Kindergarten Checkpoint 2, pp. 30–31
- Kindergarten Checkpoint 5, pp. 55–56 (Line Master 5.1)

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**

- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

#### CHOOSING INSTRUCTIONAL STRATEGIES

Consider the following strategies when planning daily lessons.

- Represent numbers in a variety of part-part-whole relationships using a variety of physical materials.
- Encourage students to display numbers in parts, whenever possible, either with manipulatives or by enacting the number physically (e.g., showing fingers, clapping).
- Encourage students to explain how they know how many are in each part of a whole.

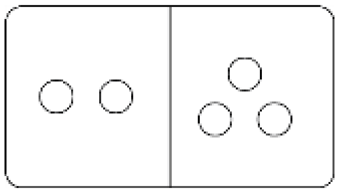
#### SUGGESTED LEARNING TASKS

- Call out a number between 2 and 10. Ask students to use their fingers to show the number that you said. For example, if you call out 7, a student may hold up 4 fingers on one hand and 3 fingers on the other hand to represent 7. Another student may hold up 5 fingers on one hand and 2 fingers on the other hand. Ask students to name the parts (the number of fingers shown on each hand) and the whole (all the fingers together). Repeat using different numbers.
- Ask students to shake and spill a handful of two-colour counters (10 or less) and record (with pictures or numerals) how many counters there are altogether (the whole) and how many of each colour there are (the parts). Students should explore making different combinations for the given

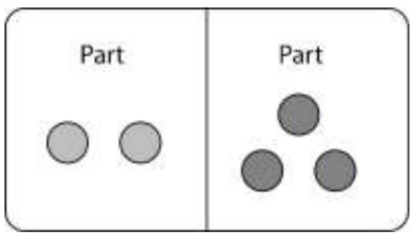
number by flipping the counters over or by repeating the shake and spill process. Students should use oral language to describe the parts and the whole. For example, if the student spills 6 red counters and 4 yellow counters, the student should say, One part is 6. The other part is 4. The whole is 10. Eventually, they should also name the quantity in each part by recording the respective numeral beside or below each part of their drawing.

- Provide students with a number of linking cubes (10 or less) and have them make a “train.” Ask students to show how many different ways they can break the “trains” of cubes into two parts.
- Ask students to separate a given number of toys (10 or less) into two groups. Ask students to describe how many are in each group and how many there are in total. Ask students to describe how many toys are in each group (part-part) and how many there are altogether (the whole).Students might play a variety of games that involve identifying the parts and the whole, for example bowling (counting both the pins knocked down and the pins left standing) or throwing bean bags (counting how many land in the target box and how many did not).
- Ask students to select a number between 5 and 10. Then, ask them to select two dot cards that combine to make that number. Challenge them to see how many different combinations they can make for their chosen number. This may also be done with dominoes.
- Use part-part-whole mats and counters and show students a set of 5 counters. Ask students to count how many are in the set. Then, partition the counters into two parts, for example 2 and 3, and ask, How many objects are there? How do you know? Observe whether students must recount all of the objects or if they know that partitioning the objects has not changed the quantity. Repeat with a different number of objects.
- Provide each student with a part-part-whole mat and counters. Say a number between 2 and 10 and ask students to place counters on their mats in two parts to match that number. Ask for different configurations for each number you say.
- Hold up dot cards with dots arranged in two parts. Ask student to name the parts and the whole. For example, if you hold up a dot card with 2 dots and 4 dots, the students say, One part is 2. The other part is 4. The whole is 6.
- Invite students to close their eyes. Tell them to picture in their heads what a number looks like. For example, ask, How do you see 4? After students have mentally pictured the number, invite them to use counters to create a representation of their mental image. Ask them to use language to describe the way they saw 4. For example, a student might say, I see 4 as 2 and 2.
- Hold up a five-frame. Ask students to respond by stating the relationship between the display number and five. For example, show a five-frame with three dots. The students respond, Three is two fewer than five. Add the two missing dots to the five-frame. Students respond, Three and two make 5. This can be repeated with ten-frames later in the year.

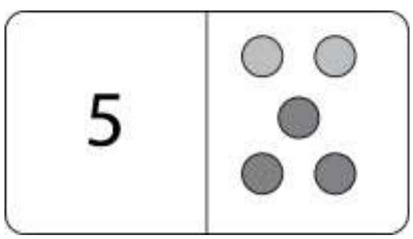
- Hold up a five-frame, ten-frame, or dot card/plate showing 10 or less. For example, if holding up a ten-frame with 4 dots, Say, I wish I had seven. The students place counters on their ten-frame to represent 4 and then count on with counters of a different colour to represent 7. Students then respond with the part that is needed to make 7. If one part is 4, the other part is 3. The whole is 7.Show a part-part-whole mat on which you have displayed two parts.



Say, if there are 2 counters on one part and three counters on the other part, how many counters are there in the whole?
Alternately, one side of the card could show




and students can be invited to call out the "whole" before you turn the card over to show




## SUGGESTED MODELS AND MANIPULATIVES

- dominoes
- dot cards
- five-frames and ten-frames
- linking cubes
- two-colour counters

## MATHEMATICAL LANGUAGE

| **Teacher** | **Student** (oral language) |
|---|---|
| ▪ familiar arrangements<br>▪ partition numbers<br>▪ parts, whole<br>▪ part-part-whole relationships<br>▪ represent | ▪ parts, whole<br>▪ part-part-whole<br>▪ represent |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 90–91
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 147–148
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 37–41, pp. 48–54

## Videos

- *Teaching Number: 0 to 9* (14:47 min.) (ORIGO Education 2010) (**Note:** Zero is not addressed in Mathematics Primary.)
- *Teaching Number: Counting* (10:49 min.) (ORIGO Education 2010)
- *Using a Hands-On Approach to Represent Numbers to 10* (13:06 min.) (ORIGO Education 2010)

## Notes

| **SCO N05** Students will be expected to compare sets containing 1 to 10 objects, using one-to-one correspondence.<br>[C, CN, V] | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**N05.01** Construct a set to show more than, fewer than, or as many as a given set.
**N05.02** Compare two given sets through direct comparison and describe the sets using words such as *more*, *fewer*, *as many as*, or *the same number as*.

## Scope and Sequence

| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **N05** Students will be expected to compare sets containing 1 to 10 objects, using one-to-one correspondence. | **N05** Students will be expected to compare sets containing up to 20 objects to solve problems using referents and one-to-one correspondence. |

## Background

Comparing is something students do many times a day. Many students start Mathematics Primary with some understanding of comparing. Young students often have a great sense of fairness that is the basis of their comparisons. For example, if they have 2 cookies and someone else has 4 cookies, they are aware they have fewer cookies.

Students in Mathematics Primary are expected to explore the concept of quantity as it relates to countable objects and to compare these quantities. Therefore, the word *fewer* is used (e.g., there are fewer counters in this set than in that set). It is interesting to note that although the concept of fewer is logically equivalent to the concept of more, the word fewer proves to be more difficult for students than the word *more*. Students will become more familiar with the term *less than* to compare numbers in later years. They will learn that 5 is less than 7 because there are 2 fewer items in a set of 5 than in a set of 7. When talking about sets that have the same number of objects, encourage the use of the terms *the same number as*, and *as many as*.

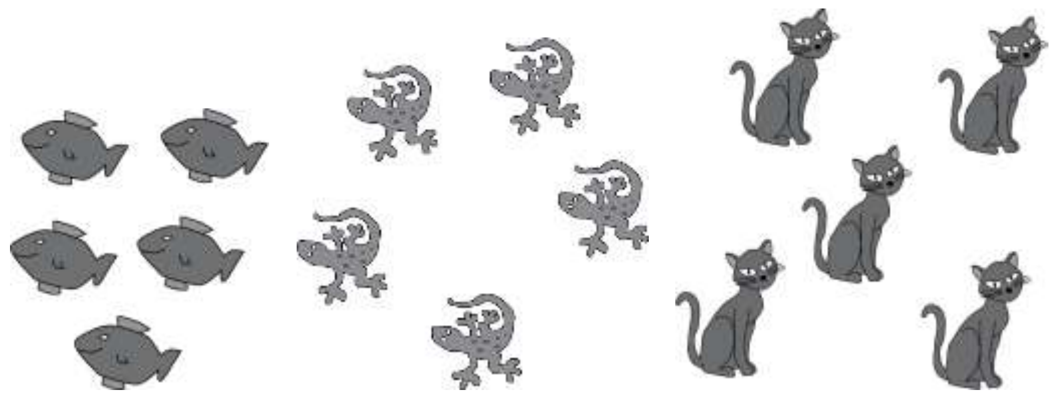
## Performance Indicator Background

**N05.01** Students should engage in activities in which they create sets that are more than, fewer than, and as many as a given set; and in which they create two sets that are more than, fewer than, or as many as one another. For example,

- place 5 counters on a paper plate and ask students to make sets that have more counters than this set
- ask students to reach into a bag of blocks, take some blocks in one hand, and place them on a paper plate, and then direct them to put fewer blocks than this on another paper plate
- display 4 blocks on a piece of paper and ask (students to use counters to make a set that is the same.)

**N05.02** Given the concrete focus of students at this stage, comparing activities should frequently involve the use of concrete materials or pictorial representations of objects that can be matched. Pictorial representations should involve multiple cards, with one picture per card, so students will be able to manipulate them. When students are able to move the objects, they can experiment and start over again. Students should have experiences comparing and describing sets in which

- the items go together, such as forks and spoons
- the items are unrelated, such as glue containers and books
- the sets have the same quantity but take up a different amount of space, such as all these pictures of 5 objects



In **Mathematics** Primary, it is expected that students will make direct comparisons (one-to-one correspondence) when comparing sets of concrete objects. Students should realize that if the sets are very different in number and the objects are of similar size, one-to-one **correspondence** counting is not really needed. When there are similar-sized objects and the sets are close in number or when the objects are quite different in size using one-to-one **correspondence** counting is useful. Using five- and ten-frames is a great way to compare two sets. With practice, students will be able to quickly identify which set has more or fewer when displayed this way. Counting two sets of objects and making a comparison just by using those two counts requires more advanced thinking. It will take time for students to be convinced that 8 of something will always be more than 5 of the same thing, or 5 of something else. However, students will eventually be able to distinguish more, fewer, and the same numbers by counting, and will not always have to use one-to-one matching.

When comparing quantities, students may use strategies that involve subitizing, which means the student can recognize the number of objects without counting. This strategy becomes more challenging and less reliable as

- the number of objects increases
- the objects in the sets are of different sizes
- the spacing between the objects is different in the two sets

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**

- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

**ASSESSING PRIOR KNOWLEDGE**

Tasks such as the following could be used to determine students' prior knowledge.

- Show students two dot cards representing two numbers between 1 to 5. Ask, Which card has more dots? Which card has fewer dots?

**WHOLE-CLASS/GROUP/INDIVIDUAL ASSESSMENT TASKS**

Consider the following **sample tasks** (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative).

- As students complete comparison tasks, consider the following:
  - Can they create a set that has more objects than a given set?
  - Can they create a set that has fewer objects than a given set?
  - Can they create a set that has the same number of objects as a given set?
  - Can they compare two sets and describe them using words such *as the same as*, *more than*, and *fewer than*?
- Give each student a blank plate. Hold up a dot plate and ask students to
  - make a set of dots that is the ‘‘same as’’ this set
  - make a set of dots with ‘‘more’’ dots than this set
  - make a set of dots with ‘‘fewer’’ dots than this set
- Give students dominoes and have them tell you which side of the domino shows more dots and which side shows fewer dots. For example, "Five dots is more than 3 dots *and* 3 dots is fewer than 5 dots."
- Use two sets of objects of differing sizes (e.g., 4 large objects in one set and 5 small objects in the other set). Ask, Which has more? How do you know?
- Show pairs of cards with sets of objects 10 or fewer (e.g., two that show sets of 8, two that show sets of 9, two that show sets of 6). As you show each pair, ask students if the cards match. Make sure that some of the pairs are not equivalent. Use large stickers or illustrations when showing these to the whole group.
- Provide representations of two different sets each of 10 or fewer. Ask students which set has more and which has fewer (e.g., one set has 9 and the other has 7).
  Hold up a dot card that has between 2 and 8 dots. Give each student a set of three cards labelled "more," "fewer," and "same." Beside each card, ask students to make a collection of counters; one set that has more, one set that has fewer, and one set that has the same as the original card. Give students a tower of 4 cubes and another tower of 7 cubes. Ask, Which is closer to 10? and then ask, How do you know? You could also ask students to tell you which is closer to 5 and to explain their thinking. Allow students to use more linking cubes to assist in solving this problem.

## Follow-up on Assessment

**Guiding Questions**

- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

### Responding to Assessment

*Numeracy Nets K–2* (Bauman 2011)
- Kindergarten Checkpoint 4, pp. 47–48 (Line Masters 2.5 and 2.6)
- Kindergarten Checkpoint 8, pp. 81–82
- Kindergarten Checkpoint 15, pp. 139–140

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**
- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

### Choosing Instructional Strategies

Consider the following strategies when planning daily lessons.

- Use materials that students can manipulate when exploring one-to-one correspondence. Avoid using drawings as students cannot move these to experiment with different strategies.
- Encourage students to work in pairs or small groups to facilitate discussion and shared thinking.
- Provide many opportunities for students to pose or answer questions such as
  - Who has fewer blocks? Who has more blocks?
  - Are there more boys or girls here today?
  - Is there a child here for every name tag?
  - Are there the same number of chairs and students?

### Suggested Learning Tasks

- Place 5 counters on a paper plate and ask students to make sets that have more counters than the given set of counters.
- Display two ten-frames, each representing a different number. Ask students, Which ten-frame has more counters? Which ten-frame has fewer counters?
- Ask students to reach into a bag of blocks, take some blocks in one hand, and place them on a paper plate. Then direct them to put fewer / more / the same number of blocks than this on another paper plate.
- Display 4 blocks on a piece of paper. Ask students to use counters to make a set that is the same.
- Have students work in pairs to play “Dot Challenge.” Provide a deck of dot cards (1 to 10 dots each) for each student. Each student turns up a card. The student who has the card with more dots gets both cards.
- Play the traditional game of dominoes where the students play their domino by matching it with one that has the same number of dots.
- Give each student a ten-frame and 10 counters. Have all students show you the number 9 with 5 counters in the top row and 4 in the bottom, filling from left to right. Now ask students to explain

what they will do to display the number 6. Ask them, Will you remove or add counters to the ten-frame? Is 6 more than 9? How do you know?

- Present students with 6 cereal boxes in a stack and 6 cans of soup. Ask, Which stack has more? Why?
- Show a set of counters, or a dot plate, five-frame, or ten-frame. Ask students to make a set of counters that has the same number of counters. Extend this to make a set of counters that has more counters. Extend this to make a set of counters that has fewer counters.
- Show students two sets of counters, for example a set of two counters and another set of six counters. Ask students to identify which set has more (or fewer) counters and to explain how they know.
- Each pair of students is given two decks of cards. One deck of cards has numerals from 1 to 10. The other deck of cards is a set of word cards, *More, Fewer, The Same As*. The students take turns selecting both a word card and a numeral card. The student must then find a dot card that represents the combination. For example, if a student drew a 4 and *more*, the student would look for a dot card that had more than 4 dots. The student would say, I found 5 because 5 dots are more than 4 dots.Hold up a two five-frames, for example, 1 and 5. Students identify which five-frame has fewer dots and which five-frame has more dots. The students respond, One is fewer than five. Five is more than one. Include five-frames that are the same. For example, hold up two five-frames each displaying 5 dots. The students would respond, Five is the same as five.
- If this outcome is being addressed in conjunction with the partitioning outcome N04, hold up a five-frame. Ask students to respond by stating the relationship between the displayed number and five. For example, show a five-frame with three dots. The students respond, Three is fewer than five. I need two more to make five.
- Hold up two ten-frames, for example, eight and five. Students identify which ten-frame has fewer dots and which ten-frame has more dots. The students respond, Five is fewer than eight. Eight is more than five.
- If this outcome is being addressed in conjunction with the partitioning outcome N04, hold up a ten-frame and the students respond by stating the relationship to ten. For example, show the ten-frame with nine dots. The students would respond, Nine is fewer than ten. (These will always be fewer than statements except when ten is held up. Students would respond, ten is the same as ten.) I need one more to make 10.

## Suggested Models and Manipulatives

- counters
- dominoes
- dot cards
- linking cubes
- links
- ten-frames

## Mathematical Language

| **Teacher** | **Student** (oral language) |
|---|---|
| ▪ compare quantities/sets<br>▪ more than, fewer than, as many as, or the same as<br>▪ one-to-one | ▪ more than, fewer than, as many as, or the same as |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 87–88
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 144–145
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 37–38

## Videos

- *Teaching Number: 0 to 9* (14:47 min.) (ORIGO Education 2010) (**Note:** Zero is not addressed in Mathematics Primary.)
- *Teaching Number: Counting* (10:49 min.) (ORIGO Education 2010)
- *Using a Hands-On Approach to Represent Numbers to 10* (13:06 min.) (ORIGO Education 2010)

## Notes

| **SCO N06** Students will be expected to demonstrate an understanding of counting to 10.<br>[C, CN, ME, PS, R, V] | | | |
|---|---|---|---|
| **[C]** Communication<br>**[T]** Technology | **[PS]** Problem Solving<br>**[V]** Visualization | **[CN]** Connections<br>**[R]** Reasoning | **[ME]** Mental Mathematics and Estimation |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**N06.01** Answer the question, How many are in the set? using the last number counted in a set.
**N06.02** In a fixed arrangement, starting in different locations, show that the count of the number of objects in a set does not change.
**N06.03** Count the number of objects in a given set, rearrange the objects, predict the new count, and recount to verify the prediction.

## Scope and Sequence

| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **N06** Students will be expected to demonstrate an understanding of counting to 10. | **N03** Students will be expected to demonstrate an understanding of counting to 20 by<br>▪ indicating the last number said identifies "how many"<br>▪ showing that any set has only one count<br>▪ using the counting-on strategy<br><br>**N07** Students will be expected to demonstrate an understanding of conservation of number for up to 20 objects. |

## Background

Meaningful counting involves an understanding of six principles of counting. These principles are addressed in various outcomes (N01, N02, N03, and N06). The principles in bold face are the ones addressed in this outcome.

1. One number is said for each item in the group and is counted once and only once. (one-to-one correspondence)
2. Counting begins with the number 1, and there is a set number sequence. (stable order)
3. **The quantity in the set is the last number said. (cardinality)**
4. **The starting point and order of counting the objects does not affect the quantity. (order irrelevance)**
5. **The arrangement or types of objects does not affect the count. (conservation)**
6. It does not matter what is being counted, the resulting count will always be the same. (abstraction)

Stable order is specifically addressed in outcome N01; one-to-one correspondence, cardinality, and abstraction are addressed in outcome N03; and this outcome specifically addresses order irrelevance and conservation. Each principle should be assessed within their respective outcome, but counting should be addressed as a single concept connecting all three outcomes.

In this outcome, students start developing an understanding of order irrelevance and conservation; however, in Mathematics 1, the development of counting will continue with the expectation of fully understanding and applying all six principles.

**Order Irrelevance:** Order irrelevance is the understanding that regardless of how objects are counted (right to left, left to right, from the middle out), it does not affect the count. Many students in Mathematics Primary will not be convinced that a different starting point or a different order of counting the objects will result in the same counts.

**Conservation:** Conservation of number is the understanding that the number of objects remains the same when they are rearranged spatially. When students do not demonstrate conservation of number, they may believe that the number of objects can increase or decrease when they are pushed out or in. The development of this principle starts in Mathematics Primary and continues in Mathematics 1.

Students may correctly count a set; however, the counting is not meaningful until they have come to terms with these two principles.

## Performance Indicator Background

**N06.01** Counting to find out how many objects are in a set is also addressed in outcome N03. It is important that students see the purpose in learning how to count and use it to perform common tasks. Ask questions or make requests in everyday situations that encourage counting of up to 10 objects. During these activities, observe whether students are spontaneously using counting as a strategy to complete these tasks; if not, demonstrate the use of counting or have a student share their strategy. This can be incorporated at any time during the day, not just during mathematics class.

**N06.02** Have students explore the order irrelevance principle. For example, place a set of counters in a five- or ten-frame and ask the students to count the objects from left to right. After students have counted the number of objects in the set, explore the order irrelevance principle by asking the students to predict how many they think they would get if they started at the right or in the middle. (They may be unsure or predict a different number than the one they just counted. These responses indicate that order irrelevance is not yet part of their understanding.) Have them count the same set of objects from the right or from the middle and focus their attention on the fact that they got the same count when they started at the left, at the right, or from the middle. (They may still believe that this is a coincidence!)

**N06.03** Similarly, have students explore the conservation principle. For example, have students count a set of objects that are close together, then push the objects out so they cover a larger area, and ask them to predict how many there are now. (They may be unsure or predict a different number than the one they just counted. These responses indicate that conservation is not yet part of their understanding.) Have them recount the objects and focus their attention on the fact that they got the same count both times. (Again, they may still believe that this is a coincidence!)

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**

- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### ASSESSING PRIOR KNOWLEDGE

Tasks such as the following could be used to determine students' prior knowledge.

- Provide students with a set of 1–5 objects. Ask them to count the objects. Note how they are counting (see observation list in Assessment Tasks below).

### WHOLE-CLASS/GROUP/INDIVIDUAL ASSESSMENT TASKS

Consider the following **sample tasks** (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative).

- Observe and note the way in which students count.
  - Do they start at 1 and say the number words in the correct sequence?
  - Do they miss or skip any numbers in the sequence?
  - Do they touch each object as they count?
  - Do they set aside items/line them up as they count them?
  - Do they realize the last number said is the quantity of objects they have counted?
  - After finishing their count, are they able to tell how many were in the set?
  - Do they recount the set to answer the question, How many were in the set?
  - Do they show confidence in their count or feel the need to check?
  - Do they correctly predict the count if the objects they have just counted have been rearranged?
  - Do they correctly count objects if they begin at different starting points?
  - Do they check their counting in the same order as the first count or in a different order?
- Present students with a set of 8 objects. Ask them to count the objects. Ask them to show you 8. Note whether they point to the last object counted or whether they show the whole set of 8 objects.
- Ask students to count a set of objects that are close together. After the students have counted the set and told how many in the set, push the objects out so they cover a larger area. Ask students to predict how many there are now.
- Ask students to take a handful of linking cubes and make a train with them. Ask students to count the cubes and tell how many cubes they have.
- Place 5 yellow cubes and 3 green cubes in a row. Ask students to count the cubes beginning with the yellow cubes. Ask them to predict how many they think they would get if they counted them again starting with the green cubes.

- Place a set of counters in a five- or ten-frame and ask students to count the objects from left to right. Ask students to predict how many they think they would get if they started counting at the right or in the middle.

#### FOLLOW-UP ON ASSESSMENT

**Guiding Questions**
- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

#### RESPONDING TO ASSESSMENT

*Numeracy Nets K–2* (Bauman 2011)
- Kindergarten Checkpoint 1, pp. 21–22
- Kindergarten Checkpoint 3, pp. 38–39

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**
- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

#### CHOOSING INSTRUCTIONAL STRATEGIES

Consider the following strategies when planning daily lessons.

- Ask questions or make requests in everyday situations that encourage counting of up to 10 objects.
- Present a set of objects in a variety of arrangements (spread out, close together, in rows) and encourage students to explore how the count remains the same regardless of the physical arrangement of the objects in the set or the starting point for counting.
- Expect students to explain, verbally, how they know how many are in a set.

#### SUGGESTED LEARNING TASKS

- Provide students with a set of objects to count. Ask them to place the objects in a container as they count. Direct students' attention to the number of objects in the container after counting has ended.
- Place a set of counters in a ten-frame. Ask students to count the objects from left to right. Ask students to predict how many they think they would get if they started at the right or in the middle. Have them count the same set of objects from the right or from the middle. Direct their attention to the fact that the count is the same whether they started at the left, at the right, or from the middle.

- Have students work in pairs. Give each pair of students a train or tower of linking cubes. Have them take turns starting at different ends of the trains or towers to count the linking cubes. Ask them whether they have the same number of cubes in the train or tower.
- Ask students to press a calculator key to show the number of windows in the room or the number of students wearing glasses. Have another student count the same objects, but in a different order to confirm the original count.
- Fill a small jar with a different item each day. Select a student to count the objects each day. Have the class confirm the number by counting aloud as the student points to each item. Be sure to vary the objects in the counting jar.
- Ask students to count the number of steps it takes to travel a specific distance, such as from the classroom door to the teacher's desk.
- Show students a set of counters, linking cubes, or countable objects. Ask students to tell the number of counters in the set. While students watch, rearrange the counters (do not add or remove any counters). Ask, How many counters are in my set now?
- Show students a set of counters arranged in a row. Count the counters from left to right with the students. Ask, If we start counting from the other end of the row, how many counters will we have? Note whether students understand that the order or direction in which they count does not affect the count.

### Suggested Models and Manipulatives

- calculator
- counters
- five-frames
- ten-frame
- linking cubes

**MATHEMATICAL LANGUAGE**

| **Teacher** | **Student** (oral language) |
|---|---|
| ▪ count the number of objects in a given set<br>▪ order, left, right, middle<br>▪ set of objects<br>▪ the counting numbers, 1 to 9<br>▪ the last number counted<br>▪ the same count | ▪ order, left, right, middle<br>▪ set of objects<br>▪ the counting numbers, 1 to 9<br>▪ the same count |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 84–86, 95
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 140–142, 151
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 39–40

## Videos

- *Teaching Number: 0 to 9* (14:47 min.) (ORIGO Education 2010) (**Note:** Zero is not addressed in Mathematics Primary.)
- *Teaching Number: Counting* (10:49 min.) (ORIGO Education 2010)
- *Using a Hands-On Approach to Represent Numbers to 10* (13:06 min.) (ORIGO Education 2010)

## Notes

# Patterns and Relations (PR)

**GCO: Students will be expected to use patterns to describe the world and solve problems.**

**GCO: Students will be expected to represent** algebraic expressions in multiple ways.

| **SCO PR01** Students will be expected to demonstrate an understanding of repeating patterns (two or three elements) by identifying, describing, reproducing, extending, and creating patterns using manipulatives, sounds, and actions.<br>**[C, CN, PS, V]** | | | |
|---|---|---|---|
| **[C]** Communication<br>**[T]** Technology | **[PS]** Problem Solving<br>**[V]** Visualization | **[CN]** Connections<br>**[R]** Reasoning | **[ME]** Mental Mathematics and Estimation |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**PR01.01** Distinguish between repeating patterns and non-repeating sequences in a given set by identifying the part that repeats.
**PR01.02** Reproduce a given repeating pattern and describe the pattern.
**PR01.03** Extend a variety of given repeating patterns to two more repetitions.
**PR01.04** Create a repeating pattern using manipulatives, musical instruments, or actions, and describe the pattern.
**PR01.05** Identify and describe a repeating pattern containing two or three elements in its core in the classroom, the school, and outdoors.

## Scope and Sequence

| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **PR01** Students will be expected to demonstrate an understanding of repeating patterns (two or three elements) by identifying, describing, reproducing, extending, and creating patterns using manipulatives, sounds, and actions. | **PR01** Students will be expected to demonstrate an understanding of repeating patterns (two to four elements) by identifying, describing, reproducing, extending, and creating patterns using manipulatives, diagrams, sounds, and actions.<br><br>**PR02**<br>Students will be expected to translate repeating patterns from one representation to another. |

## Background

Patterns exist in many aspects of life and in multiple disciplines. Nowhere is this more apparent than in the field of mathematics where patterns exist in every strand of the discipline, and the discernment of these patterns is often the very essence of learning and doing mathematics. Working with patterns enables students to see relationships, to find connections, to make generalizations and predictions, not only within mathematics, but also with other disciplines and with the world in general.

Patterns are created using various attributes, such as colour, size, shape, sound, and texture. These attributes should be the focus of students' first visual patterning. It is important that the materials used in initial experiences focus on only one attribute. For example, for colour patterns, the size and shape of the material should remain constant with only colour differences.

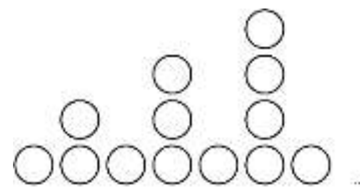
Students in Mathematics Primary need to experience repeating patterns in a variety of different ways. They need both teacher-directed and independent activities. Teacher-directed activities should encourage students to analyze a variety of patterns. Independent activities provide students with the opportunity to explore, identify, reproduce, extend, and create patterns appropriate to their level of understanding. These pattern explorations should include patterns such as AB, AAB, ABB, and ABC. When teaching the concept of patterns, it is essential to use a wide variety of manipulatives, and musical and tactile rhythms and beats.

Patterns may be represented concretely, pictorially, orally, or kinesthetically. Students will require many patterning experiences with concrete materials prior to recording patterns on paper and/or working from patterns of pictures. Students in Mathematics Primary need to be exposed to many forms of patterning, and should be able to copy, reproduce, and describe given patterns before being expected to create their own.

## Performance Indicator Background

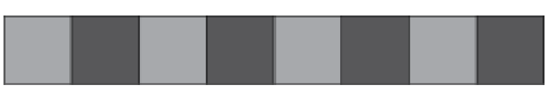
**PR01.01** Repeating patterns include the continued extension of a sequence beyond what the student can actually see. The core of a repeating pattern is the shortest set of elements that repeats. A non-repeating pattern has no detectable core; therefore, the identification of a core determines if a pattern is repeating or non-repeating.

A Repeating Pattern


A Non-Repeating Pattern

It may be more difficult for students to identify patterns where the first and last elements of the core are the same, for example, ABA patterns.

**PR01.02** Students are expected to reproduce and describe a pattern. For example, the AB pattern red, blue, red, blue, red, blue can be described as having a core of two different elements, red and blue that repeats and is, therefore, a two-element repeating pattern.



**PR01.03** Whether students are working with simple or complex patterns, encourage them to extend their pattern two more repetitions with their chosen manipulative. Occasionally, students should be asked to extend the pattern as far as they can, as this will help them solidify their understanding that patterns go on and on. Repeating the core of a pattern three times is more likely to lead students to the anticipated result; however, there may be alternative extensions unless the pattern rule is described.

**PR01.04** When creating their own patterns, students should work with concrete materials that allow them to explore and be flexible with their patterning creations. Such concrete patterns also enable students to revisit and extend patterning ideas. They should be able to describe the patterns they have created. Students enjoy the challenge of trying to determine the patterns in other students' work, so sharing their created patterns with other students is a very worthwhile activity. Students enjoy making patterns using their own bodies as they click their tongues, snap their fingers, pat their knees, or tap their toes to copy and create given patterns.

To help students understand the core of a pattern, provide students with two or more bingo daubers. Have them use the bingo daubers to create the core of a pattern on a small strip of paper and then tape that pattern to their desks. Then, ask them to create a pattern by iterating (repeating) the core on adding machine tape or long strips of paper.

**PR01.05** Provide students with opportunities to see patterns that are in their environment; for example, in the classroom, outdoors, **in other subjects**, or on their clothes. Take advantage of opportunities that arise in the classroom to identify patterns. For example, line students up to go for physical education according to different patterns. For example, boy, girl, boy, girl, boy, girl, … or short sleeve, long sleeve, short sleeve, long sleeve, short sleeve, long sleeve, ….

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**

- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### ASSESSING PRIOR KNOWLEDGE

Tasks such as the following could be used to determine students’ prior knowledge.

- Provide students with objects of two colours. Ask them to make a pattern with the objects. Note the type of pattern the students create.

### WHOLE-CLASS/GROUP/INDIVIDUAL ASSESSMENT TASKS

Consider the following **sample tasks** (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative).

- Ask students to build these pattern trains with linking cubes (e.g., RGRGRG, BYYBYYBYY, GRGRGR, BBWBBWBBW, or YRYRYR). Ask, Which patterns are the same and why?
- Show students a pattern sequence with an error and ask them what they would change to fix the pattern.
- Create an ABABAB pattern with different shapes. Show it to students and then cover the pattern. Ask students to describe or draw what would come next. Have them explain how they know. This can also be done using other patterns such as, ABBABBABB or ABCABCABC.
- Show students a set of linking cubes arranged in a repeating pattern. Ask students to
  - add the next correct piece in the pattern

  - continue the pattern with additional pieces at least twice and explain the extension
  - copy the existing pattern using sounds, actions, shapes, etc.
  - identify the core of the pattern in the longer pattern
- Tell students, I made a pattern with 10 linking cubes and then it fell apart. All I have left are three together—RBG. Show the three cubes to students. Ask them to use cubes to build what they think the pattern might have looked like. After students have completed one pattern, ask, Might it have looked another way? Encourage students to show you other possibilities. It is most important that you ask students to explain their thinking.
- Ask students to describe a pattern that they see in the classroom.
- Ask students to build a pattern train with linking cubes. Ask them to make a pattern using sounds that is the same as the pattern they built with cubes.

#### FOLLOW-UP ON ASSESSMENT

**Guiding Questions**
- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

#### RESPONDING TO ASSESSMENT

*Numeracy Nets K–2* (Bauman 2011)
- Kindergarten Checkpoint 7, pp. 72–73

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**
- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

#### CHOOSING INSTRUCTIONAL STRATEGIES

Consider the following strategies when planning daily lessons.

- Provide students with many experiences to sort objects such as paper clips, blocks, toys, beads, buttons, crayons, cubes, and counters so they can increase their awareness of attributes.
- Ask students to communicate patterns in various ways (e.g., words, letters, actions).
- Provide opportunities for students to draw simple shape patterns. Computer software may be used to aid students in creating patterns.
- Encourage students to display concrete patterns whenever possible, either with manipulatives or by enacting the pattern physically.
- Encourage students to demonstrate oral patterns, including singing or clapping/stomping.
- Expect students to explain, verbally, how they know what comes next in a pattern.

- Extend experiences with patterns further by exploring familiar skipping-rope chants and performing the actions for songs. Students also benefit from hearing stories with repeated or predictable language and repeating the patterns.
- Look for patterns in other subjects such as language arts, visual arts, and science. Patterns provide a context for the integration and application of mathematical concepts in other subjects.

## Suggested Learning Tasks

- Create a forward and backward pattern by having one student face forward and the next student face backward until all are included in the pattern around the room.
- Read a story that has a pattern, and have the students repeat the pattern once they recognize it.
- Ask students to reproduce and extend patterns that focus on
  - **auditory:** clap, clap, clap, snap, clap, clap, clap, snap, clap, clap, clap, snap, …
  - **colour:** red block, blue block, red block, blue block, red block, blue block, …
  - **shape:** ☺ ♡ ☆ ☺ ♡ ☆ ☺ ♡ ☆
- Provide a pattern and ask the student to represent it with an action pattern. For example, "green, green, blue, green, green, blue, green, green, blue, …" might be represented by "clap, clap, snap, clap, clap, snap, clap, clap, snap, …"
- Show students a repeating pattern. Ask them to identify the elements in the pattern. Ask them to identify the core of the pattern.
- Ask students to use pattern blocks or other objects to reproduce and extend a given pattern.
- Show a pictorial representation of a repeating pattern. Ask students to describe the pattern. Then, ask them to reproduce and extend the pattern using concrete objects.
- Show a pattern made with linking cubes, pattern blocks, or other objects. Ask students to describe the pattern. Ask them to reproduce and extend the pattern for two more repetitions.
- Ask students to start with three elements and to use those elements to create two different repeating patterns.
- Invite students to collect objects from nature from the playground, (e.g., pebbles, leaves, pine needles, blades of grass). Ask them to create a repeating pattern. Then, ask them to extend the pattern for two more repetitions.
- Ask students to work in pairs to create action patterns. Invite pairs to present their action patterns to the class. Invite other students to describe the action patterns.
- Show students a variety of repeating and non-repeating patterns. Ask students to identify which of the patterns are repeating patterns and to explain their thinking.
- Invite students to select a musical instrument. Ask them to use it to create a repeating pattern. Ask students to present the musical pattern and ask other students to describe the patterns they hear.
- Show students a repeating pattern that contains an error or has a missing element. Ask students to explain and correct the error or omission in the pattern.

## Suggested Models and Manipulatives

- beads
- colour tiles
- counters
- crayons
- linking cubes
- links
- paper clips
- pattern blocks
- toys

**MATHEMATICAL LANGUAGE**

| **Teacher** | **Student** (oral language) |
|---|---|
| ▪ core<br>▪ create<br>▪ describe<br>▪ elements<br>▪ extend<br>▪ identify, , ,<br>▪ non-repeating pattern<br>▪ patterns<br>▪ repeating pattern,<br>▪ reproduce | ▪ core<br>▪ elementsnon-repeating patterns<br>▪ patterns<br>▪ repeating pattern, |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 26–27, 568–573
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 603–611
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 276–279

## Video

- *Using a Teaching Sequence for Repeating Patterns* (22:55 min.) (ORIGO Education 2010)

## Notes

# Measurement

**GCO: Students will be expected to use direct and indirect measure to solve problems.**

| **SCO M01** Students will be expected to use direct comparison to compare two objects based on a single attribute, such as length, mass, volume, and capacity.<br>[C, CN, PS, R, V] | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**M01.01** Compare the length of two given objects and explain the comparison using words such as *shorter*, *longer*, *taller,* or *almost the same*.
**M01.02** Compare the mass of two given objects and explain the comparison using words such as *lighter*, *heavier*, or *almost the same*.
**M01.03** Compare the capacity of two given objects and explain the comparison using words such as *holds less***,** *holds more*, or *holds almost the same*.
**M01.04** Compare the volume of two given objects and explain the comparison using words such as *bigger*, *smaller*, or *almost the same*.

## Scope and Sequence

| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **M01** Students will be expected to use direct comparison to compare two objects based on a single attribute, such as length, mass, volume, and capacity. | **M01** Students will be expected to demonstrate an understanding of measurement as a process of comparing by<br>▪ identifying attributes that can be compared<br>▪ ordering objects<br>▪ making statements of comparison<br>▪ filling, covering, or matching |

## Background

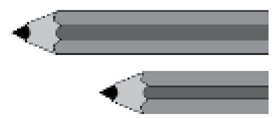
Students should realize that the same object can have many measurable attributes. Specifically, in Mathematics Primary, students will explore dimensions of 3-D objects (length, width, and height), their masses, their volumes, and their capacities by directly comparing two objects. They will come to realize that they can use their sight to compare length, volume, and capacity, but will have to use their sense of touch to compare masses. In Mathematics Primary, it is important that students focus on the measurable attributes, rather than how to measure with non-standard or standard units. Therefore, students will directly compare two objects using measurable attributes such as length, mass, volume, and capacity.
It is important that students compare measurable attributes in meaningful contexts. For example, they might compare two pencils to determine which is longer, compare two students to determine who is taller, compare two books to determine which is heavier, compare two boxes to determine which is bigger, or compare two containers to determine which holds more.

Encourage students to engage in conversations using accurate language to identify which attributes (length, mass, volume, or capacity) they can use to make comparisons. These attributes are best recognized in students' everyday experiences. For example, Scott is taller than Susan or my book bag is heavier than yours.

In length, volume, and capacity activities be sure to place the two objects that are to be compared a distance apart and/or in different positions. Ask the students to compare two objects and observe if students use a reliable strategy and are comparing the correct attribute. Students should make direct comparisons by looking at and handling the objects.

## Performance Indicator Background

**M01.01** Linear measurement refers to the length of an object and to the distance between two objects. It also refers to height, width and thickness. Students should compare lengths informally by simply viewing the length of two objects, describing them as longer or shorter, or by ordering them based on this visual inspection.



Students generally find comparisons of length easier than comparisons of mass, volume, and capacity; therefore, length activities should be the first ones they encounter. It is also easier initially for students to concentrate on the attribute under discussion if the objects' other attributes are more alike. For example, if they are asked to compare two pencils to determine which is longer, it would be beneficial if those two pencils were both the same kind and colour so the only attribute that is different is length. With more experiences, students will be able to concentrate on the attribute being **investigates** and will not be distracted by other differences the objects may have. Students will line up the two pencils side by side to compare them directly and say the pencil on top is longer than the pencil on the bottom.

**M01.02** Mass is the amount of matter contained in an object. In Mathematics Primary the ideas of ~~“~~*heavy*~~”~~ and ~~“~~*light*~~”~~ are developed as the students hold a variety of objects. In many cases the masses of two objects cannot be compared by sight; they must be held to determine which is heavier or lighter. Activities related to comparing masses should include different types of objects so comparisons must be made by lifting the objects rather than by visual means. For example, a piece of Styrofoam may be bigger than a 1-L carton of milk and yet not be as heavy. Students should use the same hand when lifting objects to compare their mass. Students can determine which is heavier or lighter by picking them up before using a double pan balance.

**M01.03 and M01.04** Capacity is often used to refer to the amount of space that can be filled. Students in Mathematics Primary require a great deal of hands on experience exploring the capacity of a variety of containers, of different sizes and shapes. The focus is on comparison, rather than on describing the capacities of individual containers.

It is particularly important in volume and capacity comparisons that minimizing the number of differences is carefully considered. Students have difficulty taking into account the effect of differences in two dimensions on capacity and volume. Objects should initially have only a difference in one dimension. For example, 250-mL, 500-mL, and 1-L milk cartons have the same square footprint, so these could be used and cut to different heights to provide activities related to questions of which holds more or less. Students should determine which holds more by filling one container and pouring the contents into the other container. For volume, students should place one object on top of, or beside, the other to determine which object is larger or smaller.

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**

- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### ASSESSING PRIOR KNOWLEDGE

Tasks such as the following could be used to determine students' prior knowledge.

- Provide students with pieces of string of different lengths. Ask them to tell which string is longer.
- Provide students with two bags containing objects of different masses. Ask them to tell you which bag is heavier.
- Provide students with two containers. Ask them which container holds less.
- Provide students with two empty boxes of different sizes. Ask them to tell you which box is bigger.

### WHOLE-CLASS/GROUP/INDIVIDUAL ASSESSMENT TASKS

- Consider the following **sample tasks** (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative). Give each student a piece of string and three pieces of paper that are labelled *shorter*, *same*, and *longer*. Ask students to find two objects that are longer than the string, two objects that are shorter than the string, and two objects that are almost the same length as the string. On the paper, students could draw pictures of the objects they found for each category.
- Give each student three pieces of paper labelled *heavier*, *same*, and *lighter*. Ask students to take off one of their shoes and then find two objects that are heavier than the shoe, two objects that are lighter than the shoe, and two objects that are almost the same mass as the shoe. On the paper, students could draw pictures of the objects they found for each category.
- Give each student a box and three pieces of paper labelled *more*, *same*, and *less*. Ask students to find two containers that would hold more than the box, two containers that would hold almost the same, and two containers that would hold less. On the paper, students could draw pictures of the objects they found for each category.
- Give each student two objects (e.g., crayon, paper clip, pencil, ruler, or eraser). Ask students to predict and then determine which item is longer or shorter. Ask students to explain their thinking.
- Give each student two objects (e.g., crayon, paper clip, large book, ruler, or stapler). Ask students to predict and then determine which item is lighter or heavier. Ask students to explain their thinking.
- Give each student two containers (e.g., one-litre milk container, empty tuna can, individual milk container, two-litre milk container, or thimble). Ask students to predict and then determine which item holds more or less. Ask students to explain their thinking.
- Have students tell you, for each of the following statements, if it is possible or impossible and explain their thinking.
  - A cat is heavier than my mom.
  - A bathtub holds less than a jug of milk.
  - My arm is longer than my foot.

#### Follow-up on Assessment

**Guiding Questions**
- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

#### Responding to Assessment

*Numeracy Nets K–2* (Bauman 2011)
- Kindergarten Checkpoint 9, pp. 89–90 (length and mass only)
- Kindergarten Checkpoint 1, pp. 97–98

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**
- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

#### Choosing Instructional Strategies

Consider the following strategies when planning daily lessons.

- Encourage students to develop intuitive notions for length, mass, capacity, and volume, using direct comparison.
- Ensure students first make estimates and then check their predictions.
- Expect students to explain how they compared two objects to determine which was longer or shorter, heavier or lighter, bigger or smaller, or held more or held less. -.
- Emphasize the importance of a base line, as students compare the lengths of objects (i.e., comparing by starting both objects at the same place).
- Explore the transitive understanding of measurement with students (i.e., if A is larger than B, and B is larger than C, then A must be larger than C).
- Discuss with students situations in which direct measurement is difficult (e.g., comparing two large objects that cannot be directly compared).

#### Suggested Learning Tasks
- Ask students to make meaningful comparisons of measurements, including
  - comparing structures they have built-in terms of height and width
  - comparing their heights and arm lengths; finding objects in the class that are shorter, longer, or about the same length as their foot
  - comparing the capacities of different types of cups, spoons, pails, boxes, and bowls
  - comparing the masses of different rocks, fruits, or vegetables
  - comparing the volume of different boxes in order to arrange them from smallest to biggest

- Ask students to describe the steps, in order, that one would take to decide which of two objects is longer. This activity can be extended to explore comparisons of mass (heavier or lighter), volume (bigger or smaller), and capacity (holds more or holds less).
- Create a sorting station at which students sort objects as longer, shorter, or about the same as a specified object at the station. This activity can be extended to explore mass, capacity, and volume.
- Ask students to estimate and then determine which of two toys is heavier by using a pan balance.
- Show students a length of string. Ask them if they think they are taller than the string without allowing them to stand beside it. After making a prediction, students should measure themselves against the string. They can then find items in the classroom that are longer and shorter than the string.

**SUGGESTED MODELS AND MANIPULATIVES**

- string
- various containers
- linking cubes
- pan balance
- various boxes

**MATHEMATICAL LANGUAGE**

| **Teacher** | **Student** (oral language) |
|---|---|
| ▪ bigger, smaller, almost the same as<br>▪ compare<br>▪ holds less, holds more, holds almost the same as<br>▪ length, width, height, mass, volume, and capacity<br>▪ lighter, heavier, almost the same as<br>▪ shorter, longer, taller, almost the same as | ▪ bigger, smaller, almost the same as<br>▪ compare<br>▪ holds less, holds more, holds almost the same as<br><br>▪ lighter, heavier, almost the same as<br>▪ shorter, longer, taller, almost the same as |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 22–23, 416–417, 421–423, 371, 430–431
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 411–416, 418–419, 461–463, 467–468, 476–477
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 227–242

## Notes

# Geometry

**GCO: Students will be expected to describe the characteristics of 3-D objects and 2-D shapes and analyze the relationships among them.**

| **SCO G01** Students will be expected to sort 3-D objects using one attribute.<br>[C, CN, PS, R, V] | | | |
|---|---|---|---|
| **[C]** Communication | **[PS]** Problem Solving | **[CN]** Connections | **[ME]** Mental Mathematics and Estimation |
| **[T]** Technology | **[V]** Visualization | **[R]** Reasoning | |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

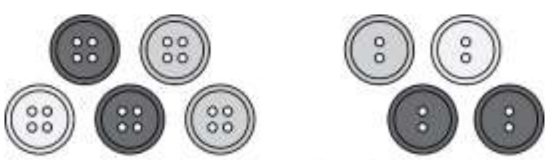
**G01.01** Sort a given set of familiar 3-D objects using one attribute, such as size or shape, and explain the sorting rule.
**G01.02** Explain the sorting rule used to sort a pre-sorted set.

## Scope and Sequence

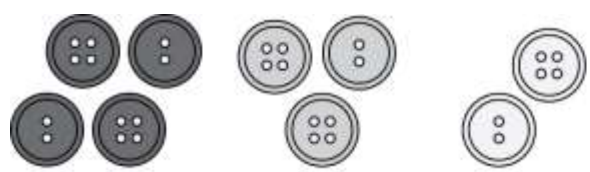
| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **G01** Students will be expected to sort 3-D objects using one attribute. | **G01** Students will be expected to sort 3-D objects and 2-D shapes using one attribute and explain the sorting rule. |

## Background

Sorting objects into groups is a natural activity. If you watch preschoolers playing with blocks, buttons, or other objects, you will see them separating the objects into groups. For example, if they are playing with buttons, you would see preschoolers putting all the buttons with four holes in one group and all the buttons that don't have four holes in another group or you might see the preschoolers sort buttons by colour. These early sorting experiences need to be fostered and extended in Mathematics Primary.



"I sorted the buttons by the number of holes in the middle."

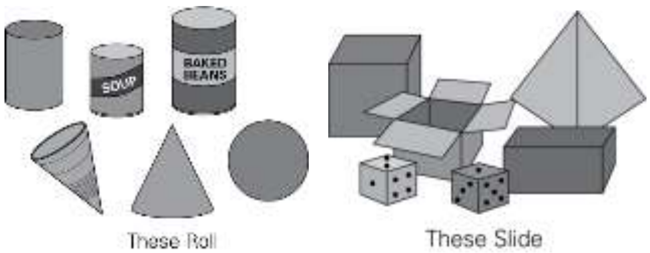


"I sorted the buttons by colour."

Before sorting 3-D objects, students should be introduced to the idea of sorting rules through activities that involve sorting themselves into groups. For example, they could be sorted into groups: students wearing sneakers and students not wearing sneakers. Choose a group of students who share something in common, such as all wearing sneakers or all wearing striped clothing. Once the selected students are standing in a group, the remaining classmates will identify the ways in which the group members are alike, which will result in the naming of the sorting rule you used. When the students have identified their rule, talk about other rules that might also apply. Ask students how they determined their sorting rule. It is important to provide students with opportunities to verbalize their sorting rule, as this helps to build and solidify reasoning skills. It also enhances students' observations of multiple attributes.

Sorting activities should be planned using sets of 3-D objects, such as boxes, cans, jars, and other containers, found around the classroom or brought in from home specifically for sorting purposes. Commercial sets of various 3-D wooden/plastic objects are available to provide students with other sorting opportunities, such as objects that come up to a point (pyramids and cones), objects that roll (cylinders and cones), and objects that do not roll (cubes and square/rectangular prisms). As you work with students, model geometric terminology such as *sphere*, *cone*, *cylinder*, cube*, prisms, and pyramids, as well as circle, triangle, square, and rectangle to describe the faces of the 3-D objects.*

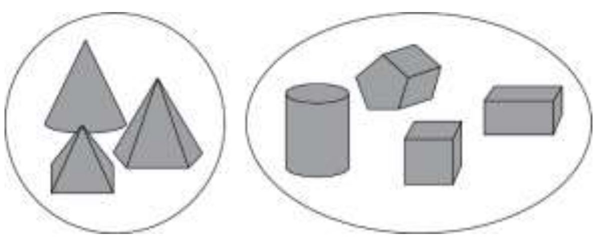
While there is no expectation that students will remember the names of the various 3-D objects, these activities provide opportunities for them to hear the names as you use correct terminology.




## Performance Indicator Background

**G01.01** In order to sort groups of objects, students need to be able to visually discriminate between objects and discuss how they are alike and how they are different. Therefore, students could be initially asked to examine one object and describe it using attributes such as flat surface, rounded surface, sharp corners, straight edges, ability to slide, ability to roll, and ability to fit together to make a bigger one of the same shape. Then, students could be asked to compare just two objects looking for how the attributes of those objects are alike and how they are different.

**G01.02** As well as being able to sort 3-D objects with assigned sorting rules or sorting rules of their own, students should be able to determine the sorting rule someone else has used to sort sets of objects. For example, students could be presented with two sets of objects and asked to determine what rule was used to sort the shapes into these two groups. They could be asked, What's my sorting rule?



Students should have many opportunities to sort objects in the context of everyday activities, for example, when putting blocks away in the building centre. With these experiences they learn that each object has many attributes and one object may be sorted in more than one way.

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**

- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### ASSESSING PRIOR KNOWLEDGE

Tasks such as the following could be used to determine students' prior knowledge.

- Provide students with a set of objects that can be sorted by one attribute. Ask them to sort the objects or to put them into groups. Ask them to explain their sorting rule.

### WHOLE-CLASS/GROUP/INDIVIDUAL ASSESSMENT TASKS

Consider the following **sample tasks** (that can be adapted) for either formative (for learning; as learning) or summative (of learning) assessment.

- Give students a set of 3-D objects and ask them to sort the objects into two groups, telling you how they decided to sort them. Make sure the objects are clearly related in at least two ways so that the students have some obvious choices (e.g., objects with rounded parts and objects with straight edges only, or very large objects and very small objects).
- Sort a set of objects into two groups. Ask students to explain your sorting rule. Ask a student to re-sort the objects. Ask students to explain their new sorting rule.
- Sort a set of objects into two groups leaving some objects out of the sort. Hold up one of the objects and ask students to identify the group to which it belongs. Have students explain their thinking and their sorting rule.
- Show students a group of objects that have been sorted. Ask them to describe the attributes of the objects in each group.
- Ask a student to sort six other students into two groups. Ask the remaining members of the class to explain how the groups were sorted.
- Sort a set of eight students into two groups based on one attribute. Ask students to identify the set to which they would belong and to explain their thinking.

### FOLLOW-UP ON ASSESSMENT

**Guiding Questions**
- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

### RESPONDING TO ASSESSMENT

*Numeracy Nets K–2* (Bauman 2011)
- Kindergarten Checkpoint 14, pp. 131–132 (Line Master 14.1)

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**
- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

### CHOOSING INSTRUCTIONAL STRATEGIES

Consider the following strategies when planning daily lessons.

- Use a variety of manipulatives and common objects for students to become familiar with the attributes of 3-D objects.
- Ask students to bring 3-D objects from home to share with the class. Invite them tell one or two attributes that they find interesting about the objects they have brought from home.

### SUGGESTED LEARNING TASKS

- Have students sort 3-D objects from around the room and block corner. Invite students to explain their sorting rule. Other questions could include
  - Explain why you put these objects together.
  - According to your (the) sort, where would ___ belong?
  - Which object does not belong to this set?
  - What other way could you sort these objects? Explain your sorting rule.
- Show students a set of 3-D objects that you have sorted. Ask students to guess your sorting rule.
- Sort a set of objects into two groups leaving some objects out of the sort. Ask students to decide where the remaining objects belong and to justify their choice.
- Invite students to sort a set of 3-D objects according to a specific attribute such as whether it rolls or doesn't roll, stacks or doesn't stack, its colour, its function, or its texture.
- Give pairs of students a mixed set of attribute blocks. Ask them to sort the blocks and to explain their sorting rules. Encourage them to re-sort the blocks in another way.

### SUGGESTED MODELS AND MANIPULATIVES

- attribute blocks
- blocks
- modelling clay
- pattern blocks
- geometric solids
- collection of objects (boxes, cans, paper rolls, etc.)
- Polydrons

### MATHEMATICAL LANGUAGE

| **Teacher** | **Student** (oral language) |
|---|---|
| • 2-D shapes: triangles, squares, rectangles, circles<br>• 3-D objects: pyramids, cones, prisms, cubes, cylinders<br>• how they are alike / how they are different<br>• smooth sides, sharp corners, ability to roll, ability to slide or ability to fit together, shapes that come up to a point<br>• sorting groups of objects<br>• sorting rule | • 3-D objects<br>• how they are alike / how they are different<br>• smooth sides, sharp corners, ability to roll, ability to slide or ability to fit together, shapes that come up to a point<br>• sorting groups of objects |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 19–21, 288–291
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 340–342, 344–347
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 191–195

## Notes

| **SCO G02** Students will be expected to build and describe 3-D objects.<br>[CN, PS, V] | | | |
|---|---|---|---|
| **[C]** Communication<br>**[T]** Technology | **[PS]** Problem Solving<br>**[V]** Visualization | **[CN]** Connections<br>**[R]** Reasoning | **[ME]** Mental Mathematics and Estimation |

## Performance Indicators

Use the following set of indicators to determine whether students have achieved the corresponding specific curriculum outcome.

**G02.01** Create a representation of a given 3-D object using building blocks and compare the representation to the original 3-D object.
**G02.02** Describe a given 3-D object using words such as big, little, round, like a box, or like a can.

## Scope and Sequence

| **Mathematics Primary** | **Mathematics 1** |
|---|---|
| **G02** Students will be expected to build and describe 3-D objects. | **G02** Students will be expected to replicate composite 2-D shapes and 3-D objects.<br><br>**G03** Students will be expected to identify 2-D shapes in 3-D objects. |

## Background

Students come to school having experience with 3-D objects. In fact, their most common experiences are those involving 3-D objects rather than 2-D shapes. They have likely played with building blocks, Lego, or other common children's toys that involve construction of 3-D objects. Structuring meaningful contexts for students in which they have opportunities to continue to explore, touch, manipulate, play, sort, and build with 3-D objects is important to developing spatial sense. Spatial sense involves visualization, mental imagery, and spatial reasoning. These skills are central to the understanding of mathematics.

Having a designated area of the classroom for building blocks and materials is important so students can regularly explore and experiment with 3-D objects. As students build, they begin to learn about the attributes of the various objects. They learn which objects stack, which roll, which objects both stack and roll, and which objects are stable and make sturdy foundations for building. It is through these investigations that students are able to learn the characteristics and properties of objects. Asking questions while the student is building with objects can provide valuable information regarding the student's concept acquisition. Students' exploration and development are enhanced by

- the teacher's questions
- space and time to build and elaborate
- opportunities to discuss their creations
- time for free play or to make future additions to the structure

As you work with students, model geometric terminology such as *circle*, *triangle*, *square*, *rectangle*, *sphere*, *cone*, *cylinder*, and *cube*; however, students are not expected to acquire this language in Mathematics Primary It is important for students to begin to understand some attributes of the various objects, such as big, little, round, like a box, like a can, or flat.

**As students work with 3-D objects, they develop spatial sense.** Spatial sense is an intuition about **objects and** shapes and their relationships and an ability to manipulate **objects and** shapes in one's mind. It includes being comfortable with geometric descriptions of **objects**, shapes, and positions.

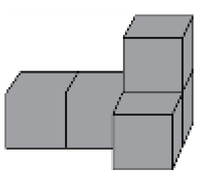
There are seven abilities in spatial sense that need to be developed in the classroom:

- **Eye-motor co-ordination**. This is the ability to co-ordinate vision with body movement. In the mathematics classroom, this is seen in children learning to write and draw using pencils, crayons, and markers; to cut with scissors; and to handle **3-D object**.
- **Visual memory**. This is the ability to recall objects no longer in view.
- **Position-in-space perception**. This is the ability to determine the relationship between one object and another, and an object's relationship to the observer. This includes the development of associated language, such as over, under, beside, on top of; and the transformations of translations, reflections, and rotations that change an object's position.
- **Visual discrimination**. This is the ability to identify the similarities and differences between or among objects.
- **Figure-ground perception.** This is the ability to focus on a specific object within group of objects, while treating the rest of the objects as background.
- **Perceptual constancy**. This is the ability to recognize an object when it is seen from a different orientation, viewpoint, or from a different distance. This perception is connected to prior experiences to enable the brain to "see" what it expects to see when it interprets visual information it receives.
- **Perception of spatial relationships.** This is the ability to see the relationship between two or more objects.

These abilities develop naturally through many experiences in life; therefore, most students come to school with varying degrees of ability in each of these seven aspects. Classroom activities should be planned to allow students to further develop these perceptions. Most spatial sense activities involve many, if not most, of the spatial abilities, although often one of them is highlighted.

## Performance Indicator Background

**G02.01** Students should be given a 3-D object and asked to build one like it, and then asked, how is your creation the same as the given object? How is it different? For example, show this shape built with cubes and ask students to build it with their blocks.



**G02.02** As students are asked to describe objects, they have opportunities to explore geometric vocabulary. After they build 3-D objects, ask them questions such as, What words can you use to describe your creation? (round, flat, shaped like a box).

As you work with students, model geometric terminology such as circle, triangle, square, rectangle, sphere, cone, cylinder, and cube; however, students are not expected to acquire this language in **Mathematics Primary**. It is important for students to begin to understand some attributes of the various objects, such as big, little, round, like a box, like a can, or flat.

# Assessment, Teaching, and Learning

## Assessment Strategies

Assessment for learning can and should happen every day as a part of instruction. Assessment of learning should also occur frequently. A variety of approaches and contexts should be used for assessing all students—as a class, in groups, and individually.

**Guiding Questions**
- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

### Assessing Prior Knowledge

Tasks such as the following could be used to determine students' prior knowledge.

- Show students a 3-D object. Ask them to describe it for you. Note the language they use to describe it.

### Whole-Class/Group/Individual Assessment Tasks

Consider the following **sample tasks** (that can be adapted) for either assessment for learning (formative) or assessment of learning (summative).

- Show the class two 3-D objects. Ask students to describe in words or pictures the similarities and differences between the two shapes.
- Show the class a 3-D object built from linking cubes. Ask students to build an object like it with the same blocks or with a different kind of block.
- Give each student enough modelling clay to build one or two objects. Ask students to build 3-D objects with the clay based on models you show (e.g., sphere, cylinder, cone, cubes and other prisms, and pyramid, and to describe how they are the same or different.
- Place four or five 3-D objects on a table and ask students to describe each one. For example, students might say, "This object looks like a can." "This one has points." "This one can roll." Cover the objects and remove one. Ask students to describe the missing object.
- Have students select 3-D objects from the block corner to construct a model of a dog house (or other simple structure). When it is completed, encourage them to talk about their creations and to provide reasons for their designs (e.g., the kind/size of the dog, sleeping space, consideration of cold weather, size of model in relation to an actual dog house).

### Follow-up on Assessment

**Guiding Questions**
- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction for the class and for individual students?

### Responding to Assessment

*Numeracy Nets K–2* (Bauman 2011)
- Kindergarten Checkpoint 13, pp. 122–123

## Planning for Instruction

Planning for a coherent instructional flow is a necessary part of an effective mathematics program.

**Guiding Questions**

- Does the lesson fit into my yearly/unit plan?
- How can the processes indicated for this outcome be incorporated into instruction?
- What learning opportunities and experiences should be provided to promote learning of the outcomes and permit students to demonstrate their learning?
- What teaching strategies and resources should be used?
- How will the diverse learning needs of students be met?

### CHOOSING INSTRUCTIONAL STRATEGIES

Consider the following strategies when planning daily lessons.

- Use a variety of manipulatives and common objects for students to become familiar with the attributes of 3-D objects.
- Ask students to bring 3-D objects from home to share with the class. Have them tell one or two things that they find interesting about what they have brought from home.
- Have students identify the shapes needed to make a 3-D object.

### SUGGESTED LEARNING TASKS

- Invite students to build imaginary buildings, monsters, or machines from 3-D objects such as boxes, cans, balls, paper cylinders, and cones. Ask them to describe their constructions.
- Have a student select, and hide from view, a wooden block. Ask the student to describe the block to the class, one hint at a time, to see if they can determine which one was selected (or have the classmates guess by asking questions without using a 3-D object name).
- Ask one student to create a structure and ask their partner to create one that is quite different and to explain the differences using comparison words (big, small, tall, etc.). Also have students create a structure that is exactly the same as their partner.
- Use a bag or box with a cover for an “Object of the Day” activity. Place different objects inside the box or bag. Ask a student volunteer to reach into the box or bag and feel the object of the day without seeing it and to describe it to the class using mathematics vocabulary (e.g., flat, round, points, curvy). Encourage students to predict the object that is in the bag based on the volunteer’s description.
- Make several different 3-D objects using linking blocks. Ask students to use linking blocks to recreate your objects. Ask them to use language to describe the objects.
- Provide a number of grocery store product containers. Ask students to describe the shapes they see.

### SUGGESTED MODELS AND MANIPULATIVES

- blocks
- modelling clay
- attribute blocks
- pattern blocks
- geometric solids
- collection of objects (boxes, cans, paper rolls, etc.)
- Polydrons

### Mathematical Language

| **Teacher** | **Student** (oral language) |
| --- | --- |
| • 2-D shapes: circle, triangle, rectangle, square<br>• 3-D object<br>• 3-D objects: sphere, prism, pyramid, cone, cylinder, and cube<br>• big, little, round, like a box, like a can, flat | • 3-D objects<br>• big, little, round, like a box, like a can, flat |

# Resources/Notes

## Print Resources

- *Making Math Meaningful to Canadian Students, K–8* (Small 2009), pp. 19–21, 284–286
- *Making Math Meaningful to Canadian Students, K–8*, Second Edition (Small 2013), pp. 340–343
- *Teaching Student-Centered Mathematics, Grades K–3* (Van de Walle and Lovin 2006), pp. 199–200

## Notes

# References

Alberta Education. 2007. *The Alberta K–9 Mathematics Program of Studies with Achievement Indicators*. Edmonton, AB: Province of Alberta.

American Association for the Advancement of Science [AAAS-Benchmarks]. 1993. *Benchmark for Science Literacy*. New York, NY: Oxford University Press.

Armstrong, T. 1999. *Seven Kinds of Smart: Identifying and Developing Your Many Intelligences.* New York, NY: Plume.

Bauman, Keith. 2011. *Numeracy Nets K–2: Bridging the Gap between Assessment and Instruction.* Don Mills, ON: Pearson Canada Inc.

Black, Paul, and Dylan Wiliam. 1998. "Inside the Black Box: Raising Standards Through Classroom Assessment." *Phi Delta Kappan* 80, No. 2 (October 1998), 139–144, 146–148.

British Columbia Ministry of Education. 2000. *The Primary Program: A Framework for Teaching*. Victoria, BC: Province of British Columbia.

Caine, Renate Numella, and Geoffrey Caine. 1991. *Making Connections: Teaching and the Human Brain.* Reston, VA: Association for Supervision and Curriculum Development.

Davies, Anne. 2000. *Making Classroom Assessment Work*. Courtenay, BC: Classroom Connections International, Inc.

Frankenstein, Marilyn. 1995. "Equity in Mathematics Education: Class in the World outside the Class." *New Directions for Equity in Mathematics Education.* Cambridge, MA: Cambridge University Press.

Gardner, Howard E. 2007. *Frames of Mind: the Theory of Multiple Intelligences*. New York, NY: Basic Books.

Gutstein, Eric. 2003. "Teaching and Learning Mathematics for Social Justice in an Urban, Latino School." *Journal for Research in Mathematics Education* 34, No. 1. Reston, VA: National Council of Teachers of Mathematics.

Herzig, Abbe. 2005. "Connecting Research to Teaching: Goals for Achieving Diversity in Mathematics Classrooms." *Mathematics Teacher,* Volume 99, No. 4. Reston, VA: National Council of Teachers of Mathematics.

Hope, Jack A., Larry Leutzinger, Barbara Reys, and Robert Reys. 1988. *Mental Math in the Primary Grades*. Palo Alto, CA: Dale Seymour Publications.

Hume, Karen. 2011. *Tuned Out: Engaging the 21st Century Learner.* Don Mills, ON: Pearson Education Canada.

Ladson-Billings, Gloria. 1997. "It Doesn't Add Up: African American Students' Mathematics Achievement." *Journal for Research in Mathematics Education* 28, No. 6. Reston, VA: National Council of Teachers of Mathematics.

Manitoba Education, Citizenship and Youth. 2009. *Kindergarten Mathematics: Support Document for Teachers*. Winnipeg, MB: Government of Manitoba.

———. 2009. *Kindergarten to Grade 8 Mathematics Glossary: Support Document for Teachers*. Winnipeg, MB: Government of Manitoba.

Manitoba Education. 2010. *Grade 1 Mathematics: Support Document for Teachers*. Winnipeg, MB: Government of Manitoba.

———. 2010. *Grade 2 Mathematics: Support Document for Teachers*. Winnipeg, MB: Government of Manitoba.

National Council of Teachers of Mathematics. 2000. *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

———. 2001. *Mathematics Assessment: A Practical Handbook*. Reston, VA: National Council of Teachers of Mathematics.

———. 2005. "Computation, Calculators, and Common Sense: A Position of the National Council of Teachers of Mathematics" (position paper, May 2005). Reston, VA: National Council of Teachers of Mathematics.

New Brunswick Department of Education. 2008. *Mathematics Grade 1 Curriculum.* Fredericton, NB: New Brunswick Department of Education.

———. 2008. *Mathematics Kindergarten Curriculum.* Fredericton, NB: New Brunswick Department of Education.

———. 2009. *Mathematics Grade 2 Curriculum.* Fredericton, NB: New Brunswick Department of Education.

———. 2010. *Mathematics Grade 3 Curriculum.* Fredericton, NB: New Brunswick Department of Education.

Newfoundland and Labrador Department of Education. 2009. *Mathematics: Kindergarten, Interim Edition.* St. John's, NF: Government of Newfoundland and Labrador.

———. 2009. *Mathematics: Grade One, Interim Edition.* St. John's, NF: Government of Newfoundland and Labrador.

———. 2009. *Mathematics: Grade 2, Interim Edition.* St. John's, NF: Government of Newfoundland and Labrador.

———. 2010. *Mathematics: Grade Three, Interim Edition.* St. John's, NF: Government of Newfoundland and Labrador.

Nova Scotia Department of Education. 2015. *Plan for Instruction Revised Time to Learn Strategy: Grades Primary-3.* Halifax, NS: Province of Nova Scotia.

———.2016. *Revised Time to Learn Strategy: Grades 4–6*. Halifax, NS: Province of Nova Scotia.

———.2010. *Gifted Education and Talent Development*. Halifax, NS: Province of Nova Scotia.

———. 2007. Mathematics Grade Primary Mental Math. Halifax, NS: Province of Nova Scotia.

———. 2017. Nova Scotia Assessment: Mathematics in Grade 4 – Lessons Learned. Halifax, NS: Province of Nova Scotia.

———. 2011. *Racial Equity / Cultural Proficiency Framework*. Halifax, NS: Province of Nova Scotia.

———. 2002. *Racial Equity Policy*. Halifax, NS: Province of Nova Scotia.

———. 2012. *Integration of Information and Communication Technology within the Classroom, 2012* (P–6). http://lrt.ednet.ns.ca.

———. 2017. Nova Scotia Assessment: Mathematics in Grade 4 – Lessons Learned. Halifax, NS: Province of Nova Scotia.

OECD Centre for Educational Research and Innovation. 2006. *Formative Assessment: Improving Learning in Secondary Classrooms*. Paris, France: Organization for Economic Co-operation and Development (OECD) Publishing.

ORIGO Education. 2010. *Developing Sight Recognition of Quantity.* Mathedology. Georgetown, ON: ORIGO Education.

———. 2010. *Teaching Number: 0–9.* Mathedology. Georgetown, ON: ORIGO Education.

———. 2010. *Teaching Number: Counting.* Mathedology. Georgetown, ON: ORIGO Education.

———. 2010. *Using a Hands-on Approach to Represent Numbers to 10.* Mathedology. Georgetown, ON: ORIGO Education.

———. 2010. *Using a Teaching Sequence for Repeating Patterns.* Mathedology. Georgetown, ON: ORIGO Education.

Rubenstein, Rheta N. 2001. "Mental Mathematics beyond the Middle School: Why? What? How?" *Mathematics Teacher,* September 2001, Vol. 94, No. 6. Reston, VA: National Council of Teachers of Mathematics.

Shaw, J. M., and Cliatt, M. F. P. 1989. "Developing Measurement Sense." In P.R. Trafton (Ed.), *New Directions for Elementary School Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Small, Marian. 2009. *Making Math Meaningful to Canadian Students, K–8.* Toronto, ON: Nelson Education Ltd.

———. 2013. *Making Math Meaningful to Canadian Students, K–8*, Second Edition. Toronto, ON: Nelson Education Ltd.

Steen, L. A. (ed.). 1990. *On the Shoulders of Giants: New Approaches to Numeracy*. Washington, DC: National Research Council.

Tate, William F. 1995. "Returning to the Root: A Culturally Relevant Approach to Mathematics Pedagogy." *Theory into Practice* 34, Issue 3. Florence, KY: Taylor & Francis.

Van de Walle, John A., and LouAnn H. Lovin. 2006. *Teaching Student-Centered Mathematics, Grades K–3,* Volume One. Boston, MA: Pearson Education, Inc.

Western and Northern Canadian Protocol (WNCP) for Collaboration in Education. 2006. *The Common Curriculum Framework for K–9 Mathematics.* Edmonton, AB: Western and Northern Canadian Protocol (WNCP) for Collaboration in Education.