Atlantic Canada Mathematics Curriculum

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CURRICULUM

Mathematics

Kindergarten

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- The teachers and other educators and stakeholders across Atlantic Canada who contributed to the finalization of the entry-grade 6 mathematics curriculum guides

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Introduction

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I. Background and Rationale

A. Background

Mathematics curriculum reform in Atlantic Canada is shaped by a vision which fosters the development of mathematically literate students who can extend and apply their learning and who are effective participants in an increasingly technological society. Curriculum reform has been motivated by a desire to ensure that students in Atlantic Canada benefit from world-class curriculum and instruction in mathematics as a significant part of their school learning experience.

The *Foundation for the Atlantic Canada Mathematics Curriculum* firmly establishes the *Curriculum and Evaluation Standards for School Mathematics* of the National Council of Teachers of Mathematics (NCTM) as a guiding beacon for pursuing this vision. These publications embrace the principles of students learning to value mathematics and of being active "doers". This is supported by Van de Walle (1997, 2), who states, "Children's learning of mathematics is based on constructivist theory which asserts that children must actively construct ideas rather than passively absorb them. NCTM publications also advocate a meaningful curriculum focussing on the unifying ideas of mathematical problem solving, communication, reasoning and connections. The foundation document subsequently establishes a framework for the development of detailed grade-level guides describing mathematics curriculum, assessment, and instructional techniques.

Mathematics curriculum development has taken place under the auspices of the Atlantic Provinces Education Foundation (APEF), an organization sponsored and managed by the governments of the four Atlantic Provinces. APEF has brought together teachers and Department of Education officials to plan and develop cooperatively the curricula in mathematics, science, and language arts in both official languages.

Each of these curriculum initiatives has produced a program, using a learning-outcome framework as outlined in Figure 1, that supports the regionally-developed Essential Graduation Learnings (EGLs). (See the "Outcomes" section of the mathematics foundation document for a detailed presentation of the Essential Graduation Learnings, and the contribution of the mathematics curriculum to their achievement.)

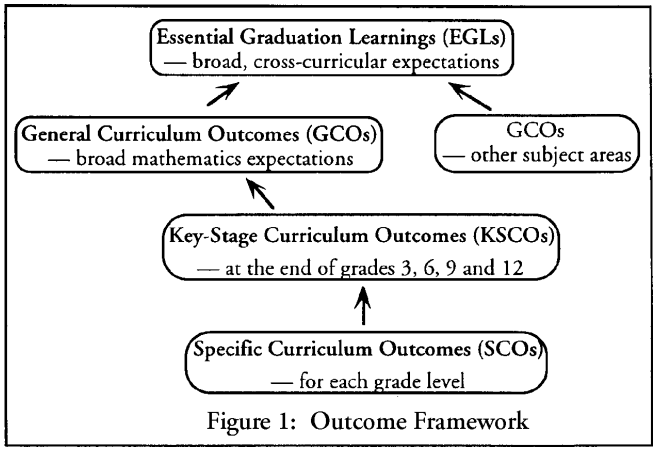


Figure 1: Outcome Framework

B. Rationale

The *Foundation for the Atlantic Canada Mathematics Curriculum* provides an overview of the philosophy and goals of the mathematics curriculum, presenting broad curriculum outcomes and addressing a variety of issues with respect to the learning and teaching of mathematics. It describes the mathematics curriculum in terms of a series of outcomes—general curriculum outcomes (GCOs) which relate to subject strands and key-stage curriculum outcomes (KSCOs) which further articulate the GCOs for the end of grades 3, 6, 9 and 12. This curriculum guide is supplemented by others that provide greater specificity and clarity for the classroom teacher by relating grade-level specific curriculum outcomes (SCOs) to each KSCO.

The Atlantic Canada Mathematics Curriculum is based upon several key assumptions or beliefs about mathematics learning which have grown out of research and practice. These beliefs include: i) mathematics learning is an active and constructive process; ii) learners are individuals who bring a wide range of prior knowledge and experiences, and who learn via various styles and at different rates; iii) 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; and iv) learning is most effective when standards of expectation are made clear with on-going assessment and feedback.

II. Program Design and Components

A. Program Organization

As already indicated, the mathematics curriculum is designed to support the six Essential Graduation Learnings (EGLs). While the curriculum contributes to students' achievement of each of these, the communication and problem solving EGLs relate particularly well to the curriculum's unifying ideas. (See the "Outcomes" section of the *Foundation for the Atlantic Canada Mathematics Curriculum.*) The foundation document then presents outcomes at four key stages of the student's school experience.

This particular curriculum guide presents specific curriculum outcomes for each grade level. As illustrated in Figure 2, these outcomes represent the means by which students work toward accomplishing the key-stage curriculum outcomes, the general curriculum outcomes and, ultimately, the essential graduation learnings.

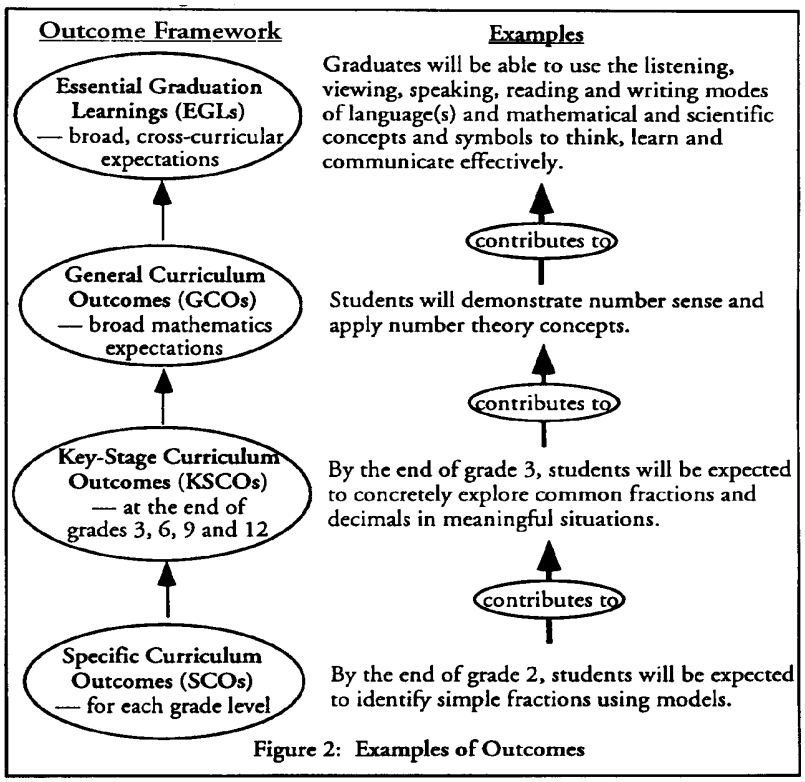


Figure 2: Examples of Outcomes

It It is important to emphasize that the presentation of the specific curriculum outcomes follows the outcome structure established in the *Foundation for the Atlantic Canada Mathematics Curriculum* and does not represent a suggested teaching sequence. While some outcomes will need to be addressed before others, a great deal of flexibility exists as to the structuring of the program. As well, some outcomes like those pertaining to patterns and data management may best be addressed on an ongoing basis in connection with other strands. It is expected that teachers will make individual decisions regarding the sequencing of outcomes. Many lessons, or series of lessons, could simultaneously address many outcomes across a number of strands.

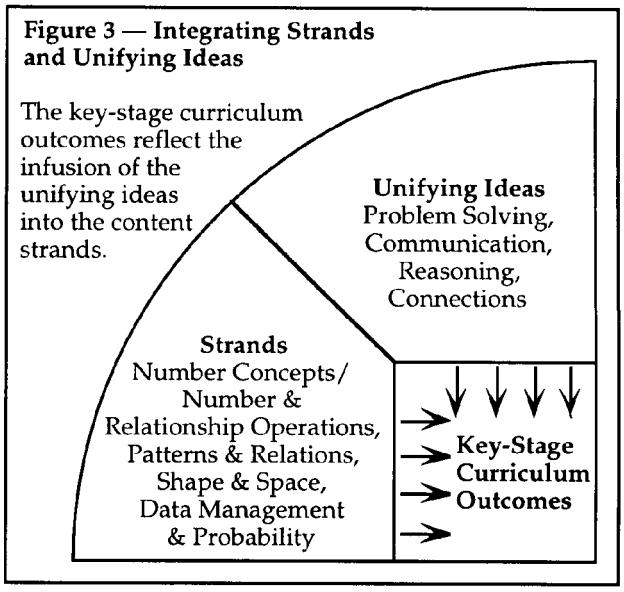
Decisions on sequencing will depend on a number of factors, including the nature and interests of the students themselves. For instance, what might serve well as a "kickoff" strand for one group of students might be less effective in that role with a second group. Another consideration will be coordinating the mathematics program with other aspects of the students' school experience. For example,

they could study facets of measurement in connection with appropriate topics in science, data management with a social studies issue and an aspect of geometry with some physical education unit. As well, sequencing could be influenced by other factors such as a major event in the community or province like an election, an exhibition, or a fair.

B. Unifying Ideas

The NCTM *Curriculum and Evaluation Standards* establishes mathematical problem solving, communication, reasoning and connections as central elements of the mathematics curriculum. The *Foundation for the Atlantic Canada Mathematics Curriculum* (pp. 7-11) further emphasizes these unifying ideas and presents them as being integral to all aspects of the curriculum. Indeed, while the general curriculum outcomes are organized around content strands, every opportunity has been taken to infuse the key-stage curriculum outcomes with one or more of the unifying ideas. (See Figure 3.)

Figure 3 — Integrating Strands and Unifying Ideas



These unifying ideas serve to link the content to methodology. They make it clear that mathematics is to be taught in a problem-solving mode, that classroom activities and student assignments must be structured so as to provide opportunities for students to communicate mathematically, that via teacher encouragement and questioning students must explain and clarify their mathematical reasoning, and that the mathematics with which students are involved on any given day must be connected to other mathematics, other disciplines and/or the world around them.

Students will be expected to address routine and/or non-routine mathematical problems on a daily basis. Over time numerous

problem-solving strategies should be modelled for students, and students should be encouraged to employ various strategies in many problem-solving situations. While choices with respect to the timing of the introduction of any given strategy will vary, strategies such as try-and-adjust, look for a pattern, draw a picture, act it out, use models, make a table or chart and make an organized list should all become familiar to students during their early years of schooling, while working backward, logical reasoning, trying a simpler problem, changing point of view and writing an open sentence or equation would be part of a student's repertoire upon leaving elementary school.

Problem Solving

Van de Walle (1997, 48) describes a problem as being "any task which involves wrestling with a new idea." Wrestling with a new idea implies that students are actively involved in construction of their own knowledge. Setting up an environment where activities are built around problems and exploration of ideas involves a rethinking of how mathematical activities are presented to students. Constance Kamii (1982, 31) illustrates this point when talking about numeracy development in young students. Preparing for snack in kindergarten often involves the distribution of cups for juice. Asking one student from each table to bring enough cups to his/her table is a very different request from telling one student from each table to bring four cups to his/her table. In the first case, students have to decide what *enough* means in this situation. They have to wrestle with the idea of *enough* and figure out a way to follow through on the teacher's instructions. In the second case, students do not have to wrestle with the idea of *enough* because the teacher has told them the number of cups needed.

The NCTM *Curriculum and Evaluation Standards* (1989, 23) emphasizes that "problem solving should be the central focus of the mathematics curriculum. As such, it is a primary goal of all mathematics instruction and an integral part of all mathematical activity." Schroeder and Lester (1989, 32) distinguish between teaching **about** problem solving, teaching **for** problem solving and teaching **via** problem solving. For example, if the situation is to decide if you have enough of something, you are teaching for problem solving. If the discussion focusses on how to act a situation out to solve the problem, you are teaching about problem solving. If you want to teach that you need four trips to take cups to a table, if there are sixteen students and you carry four cups at a time, and students figure this out on their own , then you are teaching via problem solving. The *Interactions Teacher's Resource Binder Kindergarten* (1994) suggests many problem-solving

situations which can be explored with students.

The communication that takes place when students share solutions to problems often gives teachers opportunities to assess/talk/model strategies that students can use to solve a problem. To help students develop a variety of strategies that they can use to solve routine and non-routine problems, it is important to provide large-group, small-group and individual problem-solving sessions. As students develop their own problem-solving approaches, they can apply them in new situations. Learning about, for and via problem solving is interrelated as teachers help students clarify their conceptual understanding of mathematical ideas.

Communication

The students involved in figuring out *enough* in the situation described previously may use different strategies to solve the problem. They may apply their experiences of setting the table at home and place the cups at each table by matching one cup to each person/chair. This acting out of the problem helps students arrive at a possible solution. From prior experiences of using the tables in the classroom, students may have discovered that four chairs fit comfortably at each table. These students apply the strategy of prior knowledge and counting to confirm four cups are needed. Sharing solutions to problems gives students opportunities to clarify their thinking as they interact with others. Discussion may lead to other problems which may be explored. For example:

> At one table there was one cup not used. As students talked about how this could have happened, they realized there could be a number of reasonable possibilities:
>
> 1. The student who gave out the cups matched one cup to each chair. Later the class realized there was one student sick that day so there was an extra cup at the table.
> 2. The student who gave out the cups counted the children who were sitting at the table and gave out four cups. That day apple juice was being served, and one student did not like apple juice. Although there were four students at the table, only three cups were needed.

Mathematics was traditionally viewed as a silent activity. However, students should be expected to communicate their thinking/reasoning in mathematics in the same way they do in other curriculum areas. Many students need to talk a situation through in order to understand it, and this should be encouraged. As students talk to one another, each gets a broader perspective on a problem. Sometimes, in talking to another student, a child is required to confront a misconception. In

addition, talking provides the teacher another opportunity to gain insight into what students do and do not understand. Opportunities for shared writing, talking, dramatization of a problem situation, discussion of mathematical ideas in stories, the labelling of models, drawing, painting, use of manipulative materials and writing can help students develop and clarify mathematical concepts and understandings. The resources, *Interactions Teacher's Resource Binder Kindergarten* (1994), *Early Explorations in Mathematics and Science* (Harcourt and Wortzman, 1992) and *Young Children Learning: A Teacher's Guide to Kindergarten* (1991) give many concrete examples of ways students can communicate in mathematics.

Reasoning

Many students help set the table at home and have had to make decisions about whether there were enough cups on the table. But is *enough* always the same? What would happen if guests were invited to dinner? Young students can explore this problem through their own drawings of what their tables would look like at home if an aunt and uncle were there. As students share drawings, they have the opportunity to justify their thinking. It is during this sharing that teachers can assess students' developing understanding of number.

For example:

1. I drew the table and put a chair for my mom, dad, sister and me. Then I put a chair for my aunt and a chair for my uncle. I put a cup on the table beside each chair. I know I have enough cups because there is one by each chair.
2. I know there are four people in my family. I drew those four cups. Then I drew a chair for my aunt and a chair for my uncle. I gave them each a cup. Now there are enough cups.
3. There are only three people in my family. My aunt and uncle will make two more people. I used the blocks to count how many cups I needed. I drew five cups on the table.

In the above example, students' concrete experiences of setting a table at home helped them represent their understanding in the form of pictures. Pictures supported their ability to solve the problem and communicate their ideas. In time, their thinking, supported by concrete materials and pictures, will move to an abstract level of understanding. At the kindergarten level, students need frequent experiences with concrete materials to help them think about, explore with, talk about and reason with mathematical ideas. Talking and reasoning help students develop appropriate language to describe mathematical ideas and relationships.

Mathematical Connections

To develop students' conceptual understanding in each of the mathematics strands, it is important for students to continually link their prior knowledge to new experiences. The more ways that students are given to test an idea, the better able they are to develop an understanding of mathematical concepts. The NCTM *Curriculum and Evaluation Standards* (1989, 32) states that it is important for teachers to plan activities which will help students make connections:

- between the real world and other curriculum areas
- within and among mathematical ideas
- between conceptual knowledge and symbolism

Connections Between the Real World and Other Curriculum Areas

The informal preschool experiences that students have had with mathematical ideas can be built on and expanded in kindergarten. Many hands-on experiences at the learning centres provide real-world situations in which to use mathematics. At the store, students develop numeracy skills as they count money, and at the sand and water table, they develop insights about capacity and mass. In the block corner, students develop spatial awareness as they explore space and shape. Other curriculum areas promote the development of mathematical ideas. Patterns and relationships can be explored through art, music, and movement activities. Spatial awareness is further developed through the physical education program. The environment itself offers opportunities for students to make connections to mathematical ideas being explored in the classroom. Patterns in nature, on wrapping paper and wallpaper, as well as time sequencing, are a few examples of real-life connections to the mathematics strand Patterns and Relations. Use of real-world experiences both inside and outside the classroom makes mathematics learning relevant for students. The use of literature helps students build connections between their background knowledge and mathematical ideas presented in stories. Stories can build a sound base for problem solving as students relate their language and experiences to the language of mathematics. The *Interactions Teacher's Resource Binder Kindergarten* (1994) and the resource *Read Any Good Math Lately?* (Whitin and Wilde, 1992) give suggestions for using stories and poems to develop mathematical ideas.

Connections Within and Among Mathematical Ideas

The interrelatedness of the mathematics strands makes it possible for students to see connections within and among mathematical ideas. Often, as an activity is developed to focus on one strand, other

C. Learning and Teaching Mathematics

strands can be included. For example, students examining a set of shapes might also count the number of sides of each shape and order them according to size.

Connections Between Conceptual Knowledge and Symbolism

In kindergarten, mathematical concepts are linked primarily with concrete and pictorial experiences. The focus is on the development of a conceptual understanding of mathematical ideas that will later help students move to an abstract level of understanding.

The unifying ideas of the mathematics curriculum suggest quite clearly that the mathematics classroom needs to be one in which students are actively engaged each day in the "doing of mathematics." No longer is it sufficient or appropriate to view mathematics as a set of concepts and algorithms for the teacher to transmit to students. Instead students must come to see mathematics as a vibrant and useful tool for helping them understand their world, and as a discipline that lends itself to multiple strategies, student innovation, and, quite often, multiple solutions. (See the "Contexts for Learning and Teaching Mathematics" section of the foundation document.)

The learning environment will be one in which students and teachers make regular use of manipulative materials and technology, actively participate in discourse, conjecture, verify reasoning, and share solutions. This environment will be one in which respect is given to all ideas and in which reasoning and sense-making are valued above "getting the right answer." Students will have access to a variety of learning resources, will balance the acquisition of procedural skills with attaining conceptual understanding, will estimate routinely to verify the reasonableness of their work, will compute in a variety of ways while continuing to place emphasis on basic mental computation skills, and will engage in homework as a useful extension of their classroom experiences.

Developing Mathematical Understanding

The content of the mathematics curriculum is arranged under four strands which are built upon from one grade level to the next. Each strand - Number Concepts/Number and Relationship Operations, Patterns and Relations, Shape and Space and Data Management and Probability - can be thought of as the major areas of content to be explored in mathematics. At all ages, conceptual understanding of curriculum areas will depend on prior experiences with the topics. "Mathematical concepts that children are in the process of constructing are not the well-formed ideas conceived by adults" (Van de Walle 1997, 32).

Prior to beginning kindergarten, students act and talk mathematically - sharing cookies, arranging pebbles by size, comparing their height against that of a sibling and pleading for "just two more books." Considerable informal learning about matching (developing one-to-one correspondence as cookies are shared), ordering (arranging pebbles by size), comparing (height), and classification (sorting toys) takes place in the preschool years. Smith (1997, 34-47) presents many home experiences students may have had with these early mathematical concepts, including the following:

Matching	Classification
- one sock for each foot - buttonhole for each button - party hat for each person - setting the table - toys (one driver for each car) - interaction during the sharing of books, songs, and poems	- sorting toys at home (colour, shape, size, and number) - clean-up (books on the book shelf) - laundry (towels and socks) - interaction during the sharing of books, songs, and poems

Comparing	Ordering/Seriation
- earliest experiences are opposites - weather (cold/hot) - shoes (large/small) - toys (heavy/light) - cooking (more/less) - compare quantities (more fewer cookies) - interaction during the sharing of books, songs, and poems	- events in the day (breakfast, lunch, dinner) - drawings (family members in order of size) - nesting toys - cooking utensils (measuring cups/spoons) - early counting - interaction during the sharing of books, songs, and poems - counting backwards (reverse seriation) often presented in rhymes, songs, books

Early mathematical concepts such as matching, classification, comparing and ordering help students develop logical thinking processes which they can apply in problem-solving situations. Matching is the concept of one-to-one correspondence and is one of the earliest mathematical concepts to develop. It forms a basis for the use of our number system and is a prerequisite skill for the more difficult tasks of conservation. Smith (1997, 45) defines classification (sorting) as the ability to see the *sameness* that defines members of a

group and comparing as the ability to see *differences*. Ordering involves sequencing and is another foundation of our number system. All of these concepts are interrelated and are developed through activities in each of the strands of the mathematics curriculum. For example:

Patterns and Relationships

- extending patterns involves matching, comparing, and ordering

Data Management and Probability

- creating and interpreting a picture graph involves matching, sorting, comparing, and ordering

Students' prior experiences and their understanding of mathematical ideas may be at very different levels in kindergarten. It is important that teachers interact with and observe students to ensure each child is "receiving challenging mathematical experiences" (Smith 1997, 7). The following table illustrates the wide range of understanding students may have with respect to counting in kindergarten.

Student	Counting
#1	12546378 Student has not stabilized the order of counting words.
#2	12345678910 Student can rote count to 10.
#3	Counted blocks by skipping some and counting some more than once. 1-1 correspondence not established
#4	Used 1-1 rule to count ten blocks. When asked to show the ten blocks, student touched the last block.
#5	Showed all blocks when asked to show ten blocks. Student is able to put all the blocks into a relationship and quantify the set numerically.
#6	When presented with a die, student touches each of the dots to count.
#7	When presented with a die, student can see visually without counting the dots in each set.
#8	When presented with extra counters, student starts counting from the beginning. 1234567

#9	When presented with extra counters, student can count on without having to touch every object or count from one. 4 567
#10	Mental computation (3 + 4 = 3 + 3 + 1 = 7)

D. Adapting to the Needs of All Learners

The F*oundation for the Atlantic Canada Mathematics Curriculum* stresses the need to deal successfully with a wide variety of equity and diversity issues. Not only must teachers adapt instruction to accommodate differences in student readiness as they enter the public school and as they progress, but they must also avoid gender and cultural biases. Ideally, every student should find his/her learning opportunities maximized in the mathematics classroom.

The reality of individual student differences must not be ignored when making instructional decisions. While this curriculum guide presents specific curriculum outcomes by grade level, it must be acknowledged that all students will not progress at the same pace and will not be equally positioned with respect to attaining any given outcome at any given time. The specific curriculum outcomes represent, at best, a reasonable framework for assisting students to ultimately achieve the key-stage and general curriculum outcomes.

As well, teachers must understand, and design instruction to accommodate, differences in student learning styles. Different instructional modes are clearly appropriate, for example, for those students who are primarily visual learners versus those who learn best by doing. Designing classroom activities to support a variety of learning styles must also be reflected in assessment strategies.

E. Support Resources

This and other curriculum guides represent the central reference for teachers of mathematics at various grade levels. These guides should serve as the focal point for all daily, unit, and yearly planning, as well as a reference point to determine the extent to which the instructional outcomes have been met.

Texts and other resources will have significant roles in the mathematics classroom in as much as they support the specific curriculum outcomes. Many manipulative materials need to be readily at hand, and technological resources, e.g., software and videos, should be available. Calculators will be an integral part of many learning activities. Also, professional resources will need to be available to teachers as they seek to broaden their instructional and mathematical understandings. Key among these are the *Curriculum and Evaluation Standards for School Mathematics* (NCTM) and the *Addenda Series* and *Yearbooks* (NCTM), *Elementary School Mathematics: Teaching Developmentally* or *Elementary and Middle School Mathematics: Teaching*

Developmentally (John van de Walle), *Developing Number Concepts Using Unifix Cubes* (Kathy Richardson), and *About Teaching Mathematics; A K-8 Resource* (Marilyn Burns).

F. Role of Parents

Societal change dictates that students' mathematical needs today are in many ways different from those of their parents. These differences are manifested not only with respect to mathematical content, but also with respect to instructional approach. As a consequence, it is important that educators take every opportunity to discuss with parents changes in mathematical pedagogy and why these changes are significant. Parents who understand the reasons for changes in instruction and assessment will be better able to support their students in mathematical endeavours by fostering positive attitudes towards mathematics, stressing the importance of mathematics in their students's lives, assisting students with mathematical activities at home and, ultimately, helping to ensure that their students become confident, independent learners of mathematics.

III. Assessment and Evaluation

Assessment and evaluation are integral to learning and teaching. Ongoing assessment and evaluation not only are critical for clarifying student achievement and thereby motivating student performance, but also for providing a basis upon which teachers may make meaningful instructional decisions. (See "Assessment and Evaluating Student Learning" in the *Foundation for the Atlantic Canada Mathematics Curriculum*.)

A. Assessing Student Learning

Characteristics of good student assessment would include i) the use of a wide variety of assessment strategies and tools, ii) aligning assessment strategies and tools with the curriculum and instructional techniques, and iii) ensuring fairness both in application and scoring. The *Principles for Fair Student Assessment Practices for Education in Canada* elaborates good assessment practices and it served as a guide for student assessment for the mathematics foundation document.

B. Program Assessment

Program assessment will serve to provide information to educators on the relative success of the mathematics curriculum and its implementation. It will address whether or not students are meeting the curriculum outcomes, whether or not the curriculum is being equitably applied across the region, whether or not the curriculum reflects a proper balance between procedural knowledge and conceptual understanding, and whether or not technology is fulfilling its intended role.

IV. Curriculum Outcomes

This guide provides details regarding specific curriculum outcomes for each grade. As indicated earlier, the order of presentation does not prescribe a preferred order of presentation for the classroom nor does it suggest an isolated treatment of each outcome; rather, it organizes the specific curriculum outcomes in terms of the broad framework of GCOs and KSCOs developed in the mathematics foundation document.

The specific curriculum outcomes are presented on two-page spreads (see Figure 4). At the top of each page the overarching GCO is presented, with the appropriate KSCO and specific curriculum outcome(s) displayed in the left-hand column. As well, the bottom of many left-hand columns contains a relevant quotation. The second column of the layout, entitled "Elaboration–Instructional Strategies/ Suggestions," provides a clarification of the specific curriculum outcome(s), as well as suggestions for possible strategies/activities which could be used to help students achieve the outcome(s). While the strategies/activities presented are not intended to be rigidly applied, they will help to further clarify the specific curriculum outcome(s). They will also illustrate ways to work toward the achievement of the outcome(s) while maintaining an emphasis on problem solving, communications, reasoning and connections. To readily distinguish between activities and instructional strategies, activites are introduced in this column of the layout by the symbol ❑.

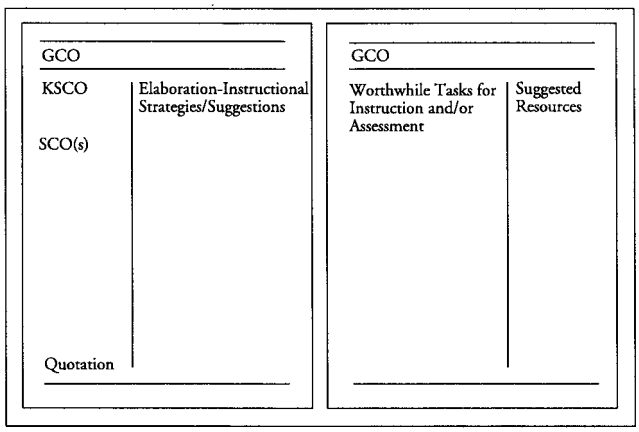


Figure 4: Layout of a 2-Page Spread

The third column of the two-page spread, entitled "Worthwhile Tasks for Instruction and/or Assessment," serves several purposes. While the sample tasks presented may be used for assessment, they will also further clarify the specific curriculum outcome(s) and will often represent useful instructional activities. As well, they regularly incorporate one or more of the four unifying ideas of the curriculum. While these tasks have headings if used for assessment (performance, paper and pencil, interview, observation, presentation,

and portfolio), teachers should treat these headings only as suggestions. These sample tasks are intended as examples only; teachers will want to tailor items to meet the needs and interests of the students in their classrooms. The final column of each display, entitled "Suggested Resources," is available for teachers to collect useful references to resources which are particularly valuable in achieving the outcome(s).

The kindergarten mathematics learning outcomes have been cross-referenced to the Department of Education curriculum document *Young Children Learning: A Teacher's Guide to Kindergarten* (1991) and the *Interactions Teacher's Resource Binder Kindergarten* (1994). The following clarifies abbreviations used under the entries for the *Interactions Teacher's Resource Binder Kindergarten* (1994).

Name: *Mathematics and Children's Literature*

Abbreviation: MCL

Name: *Big Book*

Abbreviation: BB

KINDERGARTEN - NUMBER

Number Concepts/ Number and Relationship Operations

General Curriculum Outcome A:

Students will demonstrate number sense and apply number-theory concepts.

GCO A: Students will demonstrate number sense and apply number-theory concepts.

KSCO: By the end of grade 3, students will be expected to

i) construct and communicate number meanings, and explore and apply estimation strategies, with respect to whole numbers

SCO: By the end of kindergarten, students will

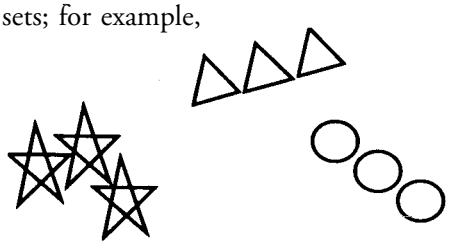
A1 sort sets on the basis of number

A2 count to determine the number in a group

Number sense was described by Howden (Arithmetic Teacher, 36(6), 1989), as "a good intuition about numbers and their relationships. It develops gradually as a result of exploring numbers, visualizing them in a variety of contexts, and relating them in ways that are not limited by traditional (rules and procedures)." (Elementary School Mathematics, p. 87)

Elaboration - Instructional Strategies/Suggestions

A1 Sorting sets on the basis of number helps students understand that a concept such as "3" has meaning in relation to the quantity of items in a variety of sets; for example,



Given the concrete focus of children at this stage, sorting activities should frequently involve the use of concrete materials, as well as pictorial representations of sets.

- ❒ Some possible activities include sorting
  - animals by the number of legs
  - buttons by the number of holes
  - clothes by the number of pockets
  - vehicles by the number of wheels
- ❒ Students might consider situations in which you usually see
  - one of something (e.g., 1 clock in a room)
  - two of something (e.g., a pair of shoes)
  - three of something (e.g., wheels on a tricycle)
  - four of something (e.g., legs on a chair)

A2 As contrasted with rote counting, meaningful counting involves an understanding of the following principles:

- One number is said for each item in the group.
- Counting begins with the number 1.
- No item is counted twice.
- The arrangement of objects is irrelevant.
- The number in the set is the last number said.

- ❒ Children might play a variety of games which require counting, for example:
  - bowling (counting both the pins knocked down and the pins left standing)
  - board games (counting the number of spaces to be moved based on a spin)
  - throwing bean bags (counting how many land in the target box)

GCO A: Students will demonstrate number sense and apply number-theory concepts.

Worthwhile Tasks for Instruction and/or Assessment

Performance

A2.1 Request that a student draw a picture of his/her favourite toys. Then ask him/her to count the number of toys in the picture.

A2.2 Provide a variety of interesting photographs involving multiple people, animals, or objects. Ask the students to tell how many are in the photographs.

A2.3 Allow students to count the number of napkins, cups, plates, etc. that are out or are needed for snack time or a special party.

Observation & Interview

A1.1 As children sort based on number, observe whether or not they
- verbalize their sorting rules
- use number names to describe their sorting rules
- attend to small detail in looking for ways to sort
- sometimes resort the same items using different number ideas

A1.2 Provide a selection of buttons. Ask the student to sort them and explain the sorting selection. Have the student sort them in another way. Another? Each time ask for the sorting rule.

A2.4 Observe children to determine their understanding of each of the principles underlying meaningful counting.

A2.5 Note the way in which students count:
- 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?

A2.6 Ask the student to count out six 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 the student how many you have altogether. Repeat using different combinations. Observe whether or not students need to count.

Suggested Resources

Young Children Learning, p. 52 Identification by matching

Interactions - Kindergarten
Investigation Bklt - pp. 19, 29, 31
Unit 1, pp. 38, 54-55, 58-59
Unit 2, pp. 70, 76-77, 85, 91
MCL - p. 25
BB - pp. 6-7, 14-15

Young Children Learning
p. 51 Name tags
p. 54 Concepts grow with maturity and experience
p. 60 Counting

Interactions - Kindergarten
Investigation Bklt - pp. 4, 7-9, 12-13, 21, 25, 29
Unit 1, pp. 36-37, 49, 53, 57-58
Unit 3, pp. 70-71, 77, 81, 84-85
MCL - pp. 4, 6-9
BB - pp. 10-11, 16-17, 20-21

GCO A: Students will demonstrate number sense and apply number-theory concepts.

KSCO: By the end of grade 3, students will be expected to

i) construct and communicate number meanings, and explore and apply estimation strategies, with respect to whole numbers

SCO: By the end of kindergarten, students will

A3 create sets of a given number

A4 explore a variety of physical representations of numbers

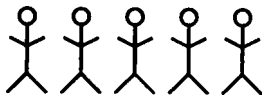
In kindergarten, number sense evolves from the total classroom experience as well as through specific activities. If we want children to develop a solid understanding of numerical concepts, we must call attention to the many ways numbers are used in everyday life, provide opportunities for children to explore number relationships with different objects, and encourage conversations about these concepts. Many materials are useful for counting and grouping: beans, toothpicks, buttons, shells, and pebbles. (Curriculum and Evaluation Standards, Addenda Series, Kindergarten Book, p. 1)

Elaboration - Instructional Strategies/Suggestions

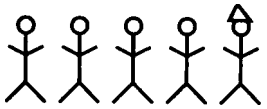
A3 Once students are able to determine the number in a group by counting, the next step is to be able to create a group of that number. This can best be accomplished in context; for example:

- ❒ Students can take turns dealing cards.
- ❒ In a dramatic play centre, children might be asked to set the table for 5, or put birthday candles on a cake for someone turning 6, etc.
- ❒ Students might tell stories involving numbers which are then dramatized, modelled or illustrated; for example:

  There were 5 children going to Sarah's birthday party.

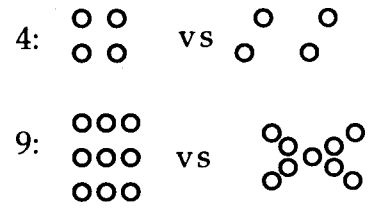


  One of the children wore a party hat. The other 4 did not.



- ❒ Ask students to count
  - the number of doors in the hallway
  - the number of steps to the top of the slide
  - the number of grey cars in the parking lot

A4 Students should recognize that there are many ways to arrange a set of objects, and that some arrangements are easier to recognize quickly than others; for example:



Particularly useful equipment would include dice, board games, dominoes, and playing cards.

- ❒ Children might
  - create their own dice
  - arrange raisins in cookies to make patterns
  - create personal counting books in which each spread shows a particular number of items, but in a variety of physical arrangements

GCO A: Students will demonstrate number sense and apply number-theory concepts.

Worthwhile Tasks for Instruction and/or Assessment

Observation & Interview

A3.1 Note student confidence and the strategies used when creating sets
- if a model set of that number is visible
- if no model set of that number is available
- with a given number of items
- which must have more items than a given amount (e.g., sets with more than 5)
- which must have exactly 1 more or 1 less than a given amount

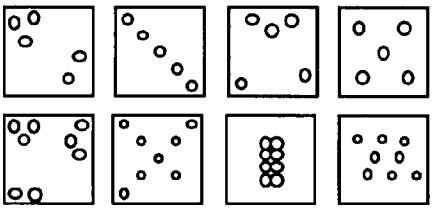
A4.1 Observe which physical representations of numbers are easier for various children to identify quickly. Note, too,
- whether children count the dots on a die or simply recognize the pattern
- whether a linear representation of a larger number makes it harder to identify than other (e.g., paired) representations
- what else children discover about representing numbers.

A4.2 Have the student roll a die and "count" the number rolled. Notice which numbers are not counted but are recognized by the configuration.

A4.3 Have students work in pairs. Provide a set of cards to each pair and ask pairs to sort them according to number. Ask: Which cards were easiest to sort? Why? (See example below.)

E.g., "5" cards

"8" cards



Portfolio

A3.2 Students might select a favourite number and create a “book” which shows that number in many different ways.

A4.4 Students may choose their favourite numbers and create and save displays that show many ways to physically model the number.

Suggested Resources

Young Children Learning
p. 60 Counting the paint brushes

Interactions - Kindergarten
Investigation Bklt - pp. 4,8,16-17
Unit 1, pp. 38-39, 56-59, 62-63
MCL - pp. 9, 21, 26
BB - pp. 16-19

Young Children Learning
p. 67 Recording, Tallying

Interactions - Kindergarten
Unit 1, pp. 59, 62

GCO A: Students will demonstrate number sense and apply number-theory concepts.

KSCO: By the end of grade 3, students will be expected to

i) construct and communicate number meanings, and explore and apply estimation strategies, with respect to whole numbers

SCO: By the end of kindergarten, students will

A5 count in a variety of ways

A6 interpret ordinal numbers

Counting skills, which are essential for ordering and comparing numbers, are an important component of the development of number ideas. Counting on, counting back, and skip counting mark advances in children's development of number ideas. (NCTM Curriculum and Evaluation Standards, p. 39)

Elaboration - Instructional Strategies/Suggestions

A5 Students should experience situations in which they count
- from 1 onward, that is , 1,2,3,. . . .
- from 10 backward, that is, 10, 9, 8,. . . .

Some students may be ready to begin counting onward from a number, for example, 4, 5, 6, ...

Counting situations should occur naturally in the course of daily tasks, such as those which occur at work centres.

To encourage "*counting on*" rather than always counting from 1, children might play a game in which they cover the starting quantity with a cloth and other items are then added.

❒ Children might
- count backwards while taking items out of the water table
- count down to special days
- count while performing finger plays or exercises
- count on while determining the total on a pair of dice

❒ Have the students count onward and backward while simultaneously creating the count on a calculator.

Press [1][+][1][=][=][=] . . . Stop at 10

Press [10][-][1][=][=][=] . . . Stop at zero

A6 Students are familiar with ordinal numbers through everyday experiences. The terms first, second, third, etc. should be regularly used in context. For example, in retelling a story, a student might tell what happened first. It is not essential to show the symbolic forms of ordinals. Most students should be able to properly use the terms first, second, and third. Some students will be able to extend ordinals further.

The most important ideas for students to realize are that

- position matters - for example, the first item in a group loses its designation if it moves
- for every "cardinal" number, there is an "ordinal" number - for example, for the cardinal number 10, the ordinal is 10th.
- first is not always fixed (i.e., may depend on point of view) - for example, when considering the arrangement of books on a ledge, the first (or second or third) will depend upon the end at which the child starts counting

❒ There are many songs and rhymes to practise counting forward and backward. NCTM's kindergarten addenda book suggests this one:

Ten little monkeys jumping on the bed,
One fell off and broke his head.
Called for the doctor and the doctor said,
"No more monkeys jumping on the bed!"

(Repeat the rhyme for nine little monkeys and so on, down to one little monkey.)

GCO A: Students will demonstrate number sense and apply number-theory concepts.

Worthwhile Tasks for Instruction and/or Assessment

Performance

A5.1 Begin counting to 10, but omit some numbers. Allow the student to fill in the numbers you skip.

A6.1 Ask students to place a set of objects so that a particular one is third. Observe whether the student believes that there should be only 3 objects or realizes that there can be more.

A6.2 Ask the students to line up five 2-colour counters in a row, same colour facing up. Direct them, for example, to turn over the first and third counters. Invite the students to provide similar directions for their classmates.

Observation & Interview

A5.2 Note whether or not students
- recognize natural counting situations
- need to line objects up to count them
- need to touch objects to count them
- need to start from the beginning when counting additional objects
- correct one another as they count together

A6.3 Observe whether or not students
- use terminology such as “first,” “second,” etc. instead of “we did this, then we..., then we...” when discussing events
- realize that first from one point of view is last from another
- are comfortable using ordinals when taking turns, lining up, describing days of the week or months of the year, etc.

A6.4 Tell the student that John said "I came in last." Mary said "You came in third." How can they both be right?

Suggested Resources

Young Children Learning
p. 60 Counting
p. 145 Frog Song, Six little ducks

Interactions - Kindergarten
Unit 1, pp. 36, 39, 42-44, 48, 57, 61, 63
Unit 5, p. 161
MCL - p. 23
BB - pp. 4-5

Young Children Learning
p. 54 Dramatizing, Verifying memory by repeating experience
pp. 60-61 Seriating
p. 63 Temporal relations

Interactions - Kindergarten
Unit 1, pp. 37, 51-53
MCL pp. 18, 29
BB pp. 10-13

GCO A: Students will demonstrate number sense and apply number-theory concepts.

KSCO: By the end of grade 3, students will be expected to

ii) concretely explore common fractions and decimals in meaningful situations

SCO: By the end of kindergarten, students will

A7 recognize the meaning of halves when used in context

Elaboration - Instructional Strategies/Suggestions

A7 Although no formal work with fractions is expected at kindergarten, students should become familiar with the concept of one-half and recognize the term as it is commonly used. The goal should be to stress the concept of "fair shares." Explorations should be provided to add to their previous experiences of sharing with another person.

Part of a whole (area model): The sharing of a brownie, a piece of licorice, or a piece of paper is commonplace to students. The more opportunities they have to partition fairly, the better their visual concept will be for a half.

Part of a set: The students' experiences with sharing often involve finding fair shares of a set of objects. This generally involves partitioning one at a time to each person to ensure that the sharing is fair. The number each gets is irrelevant. For example, when sharing a package of candies, children will give "one for you, one for me" without determining how many each gets in total. As with the part of a whole, it is important that the children develop a mental image of what a "half" of a set looks like.

Students should be aware that, when talking about one half,

- two sharers are involved,
- the size of the half is dependent on the size of the whole,
- each sharer gets a part of something, whether a group of objects or an individual item that is cut up, and
- the sharing is fair.

❒ One activity might involve sharing a box of raisins. Invite two students to share the box, offering each one half. Suggest that they decide what to do to accomplish this. Ask why you could not invite three students over to each get one half.

❒ Provide many opportunities for students to estimate "one half", for example, one half of

- a pile of baseball cards
- a jar of pencils
- a chocolate brownie

Young children find estimating difficult. Regularly provide tasks using the word "about"; for example, "Show me about one half of the blocks."

❒ Place a number of sets of objects and single items on a table. (Use, for example, a set of baseball cards, some pogs, a piece of licorice, some books, some pennies, a glass of juice, a bunch of crayons, etc.). Tell the students a story, beginning with, "Martha and Mark are twins. They always share fairly and are happy when they know each has half. How would Martha and Mark share these items?" Have a "Martha" and a "Mark" take turns sharing. Encourage the students to verbalize as they divide up the objects.

GCO A: Students will demonstrate number sense and apply number-theory concepts.

Worthwhile Tasks for Instruction and/or Assessment

Performance

A7.1 Break a muffin into two equal pieces for two children. Ask if they think that each has half.

A7.2 Ask the child to create a picture which is half red and half blue.

A7.3 Provide a collection of 20 counters or blocks. Ask the student to show you about one half without sharing them out. Have him/her explain how one might check to see how close to a half it is.

A7.4 Ask students to use colour tiles to make a design in which half the tiles are one colour and the other half are a different colour.

Observation & Interview

A7.5 Note whether or not the student uses the term half to mean any sort of sharing situation, regardless of number involved.

A7.6 Ask the student to tell you when he/she has received half of something.

A7.7 Show the student a set of 6 pencil crayons, a glass of juice, and a package of raisins. Ask: Which is the easiest to find one half of and which would you find most difficult to divide in half? Why?

A7.8 Provide examples and non-examples of wholes that are divided to represent halves. Ask the students to identify the wholes that have been divided fairly and to explain their thinking.

Paired Presentation

A7.9 Provide a picture of an irregular shape. Have the students work in pairs to estimate where to draw a line to divide it in half. Invite them to explain their reasoning.

Suggested Resources

Interactions - Kindergarten
Investigation Bklt - p. 25
Unit 4, p. 120
Unit 5, pp. 148, 167-170
MCL - pp. 7, 13, 18, 21, 25
BB - pp. 42-43

GCO A: Students will demonstrate number sense and apply number-theory concepts.

KSCO: By the end of grade 3, students will be expected to

iii) read and write whole numbers and demonstrate an understanding of place value (to four places)

SCO: By the end of kindergarten, students will

A8 use symbols to represent numbers

Elaboration - Instructional Strategies/Suggestions

A8 Numeral writing should be taught as needed and requested, that is, as students are ready to record information and need to write the appropriate numeral. Observe the students as they write their numerals, both when copying from a model and when forming them from memory. Because it is important that they develop an efficient means of recording numerals, direction and practice are required. One suggestion for practice is to use their index fingers to form the numerals on their desks, in the air, or in the sandbox.

Students may initially use their own number symbols if they wish, but should soon realize that a conventional symbol makes communication easier.

- Students might
  - write their phone numbers in a class book
  - use a tally or invented system to record changing amounts
  - record numbers on a hopscotch grid or number line
  - copy numbers from the environment
- Students might 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).
- Provide a calculator for each student. Direct students to show a particular number on the display. To confirm their responses, write the symbol on the board, display it on an overhead calculator, or show a large number card. Repeat the process by having students clear their displays and then calling out (or having a student call out) another number.

  Variation: Ask students to press the key to show
  - the number of windows in the room
  - the number of lights in the ceiling
  - the number of students wearing jeans

GCO A: Students will demonstrate number sense and apply number-theory concepts.

Worthwhile Tasks for Instruction and/or Assessment

Performance

A8.1 Ask the student to paint a picture that includes at least one copy of the symbol for a number the student likes.

A8.2 Have the student draw some original symbols that he/she thinks might be good ones to describe five of something.

A8.3 Provide each of the students with cards on which the numerals 1 to 5 are written. Make number arrangements on an overhead, using bingo chips. Ask the students to select, and raise in the air, the number card that represents the arrangement.

Observation & Interview

A8.4 As children record numerical information, observe whether or not
- they recognize the standard number symbols, even when they are stylized
- they seek out opportunities to practise their numeral writing, either in sand, in the air, or on paper
- they create their own symbols
- invented symbols bear any relationship to the standard symbols
- their invented symbols somehow reflect the actual number being recorded

Suggested Resources

Young Children Learning
p. 67 Recording, Tallying

Interactions - Kindergarten
Investigation Bklt - pp. 4, 6, 8, 11, 13, 15, 29, 31
Unit 1, pp. 36, 39, 43, 49, 54, 61-63
Unit 2, p. 90
MCL - p. 4
BB - pp. 4-5

GCO A: Students will demonstrate number sense and apply number-theory concepts.

KSCO: By the end of grade 3, students will be expected to

iv) order whole numbers and represent them in multiple ways

SCO: By the end of kindergarten, students will

A9 determine which group has more, which has less, or whether groups are equivalent

While the concept of "less" is very similar to the concept of "more," the word "less" proves to be more difficult for children than does "more" . . . To help children with the concept of "less," frequently pair it with the word "more" and make a conscious effort to ask "which is less" questions as well as "which is more" questions. (Elementary School Mathematics, p. 89)

Elaboration - Instructional Strategies/Suggestions

A9 Most students have an intuitive idea that, in deciding whether one group is more than another, it is possible to match items up in one-to-one correspondence to see if one group has any leftovers.

Students should have many opportunities to pose or answer questions such as

- Who has less? Who has more?
- Are there as many napkins as plates?
- 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?

Students should have experiences matching sets in which

- the items go together (e.g., forks and spoons)
- the items are unrelated (e.g., glue containers and pieces of paper for the children at the art table)

❒ Children can vote for an idea. To clarify the results, the "yes" line and the "no" line can hold hands to find which line has more (or less).

❒ Ask students to shake and spill a handful of 2-colour counters and then spin a "more/less/same" spinner. Based on the spinner results, the students will make a "more/less/same" prediction such as "I think there are more red counters" or "I think there are fewer yellow counters." Ask students to verify their predictions.

❒ Invite students to play "Dot Challenge." Provide a deck of dot cards (1 to 10 dots each). Each student turns up a card; the student who has the card with the greater number of dots gets both cards. The winner is the one who finishes with the greater total number of cards.

Note: Children who can successfully distinguish more, less and equivalence by counting need not engage in one-to-one matching activities.

GCO A: Students will demonstrate number sense and apply number-theory concepts.

Worthwhile Tasks for Instruction and/or Assessment

Performance

A9.1 Ask students to put out less (fewer) of one item than another, for example, less (fewer) pencils than crayons.

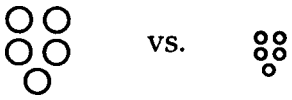
A9.2 Have students check in the toy bin to see if there are more of one item than another, for example, more trucks than cars.

A9.3 Ask the child to build a building with more of one type of block than another.

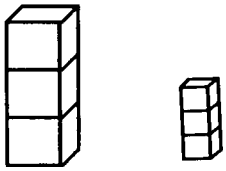
Observation & Interview

A9.4 Observe whether or not the following extraneous factors influence children as they compare

- arrangements which take up different amounts of space; for example,

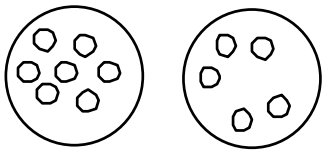


- arrangements involving different heights; for example,



A9.5 Note whether or not children regularly use matching to answer questions such as whether there are enough napkins for everyone in the group or enough skipping ropes for those who want them.

A9.6 Place counters on each of 2 mats/paper plates/jar lids.



Ask students which has fewer. Encourage them to talk about it, not just indicate by pointing. ("This one has fewer and this one has more.") An extension would be to have the students make the sets the same size.

Suggested Resources

Young Children Learning
p. 51 Name tags
p. 54 Concepts grow with maturity and experience
p. 60 Counting
p. 86 Targets

Interactions - Kindergarten
Investigation Bklt - pp. 6, 9, 12, 14-15, 17, 21, 25, 29, 31
Unit 1, pp. 37, 39, 44-50, 56
Unit 2, pp. 68-69, 71, 82-85, 86-89, 91
MCL - pp. 6, 9, 22, 24, 27
BB - pp. 6-9, 14-15

KINDERGARTENB - OPERATIONS

Number Concepts/ Number and Relationship Operations

General Curriculum Outcome B:

Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

KSCO: By the end of grade 3, students will be expected to

iii) create and model problem situations involving whole numbers, using one or more of the four basic operations

SCO: By the end of kindergarten, students will

B1 count the results when small groups are combined

B2 count the results when small groups are separated

. . . "Operation sense," a highly integrated understanding of the four operations and the many different but related meanings these operations take on in real contexts. (Elementary School Mathematics, p. 109)

Elaboration - Instructional Strategies/Suggestions

B1 Many students are capable of adding informally. It is important to provide many experiences in which students will be combining and counting sets of a variety of manipulative materials. The intent at this level is to treat addition as a counting situation without any formal attempt to symbolize it.

Students should become involved in situations in which

- action is involved (e.g., some objects are added to an existing group)
- no action is involved (e.g., two existing groups are considered together for some purpose)

Students should come to understand that the act of combining groups increases the count of either original group.

❒ Students might
- work with play (real) coins in a pretend (real) yard sale. They could price items using small penny amounts and determine the cost if two or more items are purchased.
- consider amounts combined in recipes (e.g., a cup of sugar added to 2 cups of flour).

❒ Ask students to make 2-colour bars, using connecting cubes (e.g., 5 blue and 3 red). Ask the students to tell you about the number of cubes. (Note: This may also be an opportunity to look at patterns; for example, 2 red, 1 blue, 2 red, etc. See SCO C1.)

❒ Ask students to work in pairs. The first student rolls a die, counts out the number of blocks indicated by the die, and places them on a mat. The second student does the same, adding the blocks to those of his/her partner. Have them count to determine the results of the combination.

B2 Many students deal with experiences which involve removing or separating items from a group to determine how many are left. This form of subtraction would only be dealt with informally at the kindergarten level.

❒ Students might count how many are left when
- 4 green speckled frogs are sitting on a log and 1 leaves
- 6 raisins are on a plate and 6 are eaten

❒ Model "take-away/separation" stories. Invite students to make up their own stories and present them to their classmates to solve, using materials; for example:
- Sue had 10 blocks. She gave 3 of them to her friend, Brian. How many does Sue now have?
- James has 4 crackers. He eats one. How many are left?

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Worthwhile Tasks for Instruction and/or Assessment

Performance

B1.1 Ask the child to combine two groups and tell how many items there are altogether.

B1.2 Use a spinner marked off with the numbers 1 to 5. After spinning, the student will place the indicated number of beans on a mat/plate. Have the student spin once again and add the corresponding number of beans to the pile. Ask: How many are in the combined group? Observe whether the student counts on from the first number or counts the entire combined group.

B1.3 Ask the child to divide a set of toys into two groups based on a criterion of his/her choice. The child can then tell how he/she separated the groups (or could ask the teacher to guess the criterion) and describe how many are in each part and how many there are in total.

B1.4 Model for the class a number of "stories" involving the combination of sets. Invite the students to make up their own stories and present them to their classmates to solve, using materials; for example:

> Margo has 4 crayons. Mario gave her 2 more. How many does Margo now have?

B2.1 Ask the child to remove items from a group and tell how many are left.

B2.2 Tell the student a subtraction story and ask him/her to model it using materials, for example: You have 8 individual packets of crackers. Five students want crackers for snack time. How many packets will you have left?

Observation & Interview

B1.5 Observe children as they find totals to determine whether or not they
- count on from the original amount
- count on from the greater amount
- count each individual item
- can keep track only when the numbers are quite small
- can find totals above ten

B2.3 Observe how students determine the number remaining, to see if they
- start with the first number and count backwards
- count forward those items that are left
- sometimes "take away" mentally rather than laying out the items
- find certain combinations more quickly than others (e.g., those in which only one is subtracted)

Portfolio/Presentation

B2.4 Ask students to illustrate a subtraction number story. Have them use their pictures when telling their stories to the group/class.

Suggested Resources

Interactions - Kindergarten
Investigation Bklt - pp. 15, 27
Unit 1, p. 57
Unit 5, pp. 148-151, 154-157, 160-161, 170-172
MCL - pp. 5, 7-8, 13, 15, 21, 25, 27, 29-30
BB - pp. 18-19, 40-43

Young Children Learning
p. 51 Name tags

Interactions - Kindergarten
Investigation Bklt - p. 27
Unit 1, p. 57
Unit 2, p. 77
Unit 5, pp. 148, 150-151, 158-159, 161, 170, 172
MCL - pp. 4, 13, 25
BB - pp. 42-43

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

KSCO: By the end of grade 3, students will be expected to

iii) create and model problem situations involving whole numbers, using one or more of the four basic operations

SCO: By the end of kindergarten, students will

B3 determine how many more one group has than another

. . . "Operation sense," a highly integrated understanding of the four operations and the many different but related meanings these operations take on in real contexts. (Elementary School Mathematics, p. 109)

Elaboration - Instructional Strategies/Suggestions

B3 An important meaning of subtraction which might begin informally in kindergarten is the comparison meaning. The student is trying to determine how many more one group contains than another. These situations arise every day – How many more cookies do you have than I? How many more pennies does my brother have than I have?

Students would be dealing with relatively small group sizes at this level. At this time, there is no intention to introduce the term subtraction.

Some students will realize that an easy way to compare is to use one-to-one correspondence; that is, if both groups are lined up in a one-to-one way, we can just count how many extras there are in the larger group. Teachers might even want to set up a grid for this; for example, if I have 6 pencils, and you have 4, I have 2 extra.

X	X	X	X	X	X				
0	0	0	0						

Some students will approach this question in other ways; for example, laying out 4 and counting up to see how many extra to get to 6.

- ❒ Invite pairs of students to take turns throwing a die and making towers with corresponding numbers of cubes. Have them tell which tower is taller and by how much.
- ❒ Give a student some pennies. Use the "store" corner where items are individually priced (in pennies). Ask: How much more does ____ cost than ____ ? Which items do you not have enough pennies to buy? How many more pennies would you need?

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Worthwhile Tasks for Instruction and/or Assessment

Performance

B3.1 Put out 2 sets of counters. Ask the child to show how many more one set is than another.

B3.2 Tell the student that a zoo has 5 bears and 3 giraffes. Ask him/her to choose a material to model how many more bears there are than giraffes.

Observation & Interview

B3.3 Observe how students determine how many more, to see if they
- set up a one-to-one correspondence and count extras
- count up from the lesser number to the greater

B3.4 Ask the student to look at the coins in each of your hands and determine which hand is holding more and how many more.

B3.5 Observe to see whether students who are setting a table for snacks count up to figure out how many more napkins are needed.

Portfolio/Presentation

B3.6 Ask students to draw a picture which shows a situation in which they might want to know how many more are in one group than another.

Suggested Resources

Young Children Learning
p. 59 Do we have more plates or

Interactions - Kindergarten
Investigation Bklt - p. 12
Unit 1, pp. 46, 49, 56, 63
Unit 2, pp. 68-69, 86, 91
MCL - pp. 6, 16, 20, 22, 24
BB - pp. 4, 5, 6, 7, 8, 9, 16, 17, 24, 25

KINDERGARTEN - PATTERNS

Patterns and Relations

General Curriculum Outcome C:

Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

KSCO: By the end of grade 3, students will be expected to

i) recognize, describe, extend, and create patterns and sequences in a variety of mathematical and real-world contexts (e.g., geometric, numeric and measurement)

SCO: By the end of kindergarten, students will

C1 copy and extend patterns including those involving number, shape, size and colour

Pattern is a unifying theme that weaves mathematical topics together. The study of patterns supports children in learning to see relationships, to find connections, and to make generalizations and predictions. Understanding patterns nurtures the kind of mathematical thinking that helps children become problem solvers and abstract thinkers. It is a problem-solving tool.

Children first explore patterns with their own bodies, actions, and words. They see and hear patterns in the world around them. Before creating pictorial representations and patterns at symbolic levels, children need objects with which to make patterns. (Curriculum and Evaluation Standards, Addenda Series, Kindergarten Book, p. 1)

Elaboration - Instructional Strategies/Suggestions

C1 Children notice and hear patterns in many contexts. It is important to help them recognize the mathematical aspects of these patterns. Kindergarten children enjoy being part of action and word patterns. Before they can create patterns, children need a great deal of experience with given patterns. For example, use children to model a "stand, sit" pattern and then have small groups copy the pattern. Expand it to more components when the children are able to handle them, for example, "stand, sit, stand, lie down" and other combinations. Have the children chant the pattern as they perform the actions.

❒ Action patterns could include, among others,
- clap hands, slap knees
- touch toes, pat head, turn around
- clap, clap, snap

Patterns can be extended further by exploring familiar skipping-rope chants and performing the actions for such songs as the Hokey-Pokey. Children also benefit from hearing predictable books and repeating the patterns. Children will require many patterning experiences with concrete materials prior to recording patterns on paper and/or working from patterns of pictures.

Have students reproduce and extend patterns that focus on

- auditory patterns - e.g., Clap, clap, clap (pause), clap, snap, (pause), clap, clap, clap, (pause)
- number of like objects - e.g.,
- orientation, - e.g.,
- number of sides, - e.g.,
- shape, - e.g.,
- colour, - e.g., red block, blue block, red block, green block

Encourage the children to talk about patterns and include pattern activities across the curriculum, particularly in art and music classes.

Note: It is important that students recognize that there may be a number of ways to extend patterns, all equally correct. For example, ABC could be extended to ABCABC . . . or ABCDEF . . . or ABCCBA . . . or ABCabcABC, etc.

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

Worthwhile Tasks for Instruction and/or Assessment

Performance

C1.1 Ask the student to copy a set of actions that you model to form a pattern, such as "clap, clap, snap, snap, clap" or "snap, pause, snap, pause, snap, snap, snap."

C1.2 Ask the student to use concrete materials to reproduce a given pattern, for example,

C1.3 Show a pictorial representation of a pattern and ask the student to use materials (buttons, for example) to reproduce and extend it.

C1.4 Observe the students as they play such games as "Head and Shoulders" or "The Hokey-Pokey."

Observation & Interview

C1.5 Show a colour pattern and ask the student to describe it; for example, "red cube, red cube, yellow cube, red cube . . . "

C1.6 Read a story that has a pattern and observe when the child recognizes and can repeat the pattern.

C1.7 Note the ease with which students
- recognize patterns
- copy patterns with materials
- copy patterns involving body movements
- describe patterns verbally

Activity

Use attribute blocks (or make a set of 2-D shapes of different sizes and colours). Have a small group of students work together to make a train with each connecting block differing by one attribute. Teacher may be part of the group to model and promote discussion.

Suggested Resources

Young Children Learning
p. 61 As they finish clean-up
p. 18 Observing
p. 21 Spatial awareness
p. 114 Textures and patterns

Interactions - Kindergarten
Investigations Bklt - p. 17
Unit 1, pp. 60-63
Unit 4, p. 141
MCL - pp. 4-5, 16, 23, 26-27
BB - pp. 4-5

Interactions - Kindergarten
Unit 1, pp. 60-61
Unit 3 pp. 96-97, 99, 112-116
MCL - pp. 16, 22
BB - pp. 32-33

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

KSCO: By the end of grade 3, students will be expected to

i) recognize, describe, extend, and create patterns and sequences in a variety of mathematical and real-world contexts (e.g., geometric, numeric and measurement)

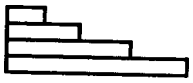
SCO: By the end of kindergarten, students will

C2 copy patterns based on measurement attributes

Elaboration - Instructional Strategies/Suggestions

C2 Measurement attributes provide yet another alternative for students engaged in pattern making. Provide students with patterns that include variations in size, in mass, in capacity, and in time. (Note: This type of patterning can be done in conjunction with work in the Shape and Space strand.)

Some patterns that might be explored:



- Size: Ask the students to order Cuisenaire Rods based on length.
- Mass: Provide Plasticine balls of different sizes and have the students create a pattern based on mass.
- Capacity: Provide multiple samples of containers of different sizes. Have the students create and explain their capacity pattern.
- Time: Explore patterns found in nature; for example, spring follows winter, summer follows spring and so on. These are patterns that never change. Point out to the children the established patterns that make up their kindergarten daily schedules and have them share patterns that they regularly follow at home.

C3 It is important to remember that children at this age need to be exposed to many forms of patterning and should copy, or reproduce, given patterns before being expected to create their own.

❒ Have students form small circles, each having a different "musical instrument." Ask one student to create a pattern that the next student will copy with his/her instrument. Continue around the circle, and proceed in the same way with a different student creating the pattern.

(Note: Instruments would include the traditional rhythm band student instruments, as well as those made from classroom materials, such as spoons, a block and a stick, two chalkboard erasers, or a tin can with pebbles inside. A creative assignment would be for students to design their own "instruments" from materials in the classroom or from home.)

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

Worthwhile Tasks for Instruction and/or Assessment

Performance

C3.1 Provide multiple samples of different lengths of string. Ask the student to select some, arrange them in a pattern, and describe the pattern.

C3.2 Provide a number of pencils of different lengths and ask the student to use some to create a pattern. Ask the student to explain his/her pattern.

C3.3 Provide the student with a number of cookie cutters and ask him/her to create a repeating pattern in rolled-out plasticine dough.

C3.4 Ask the students to create a repeating pattern with finger paints.

C3.5 If appropriate for your students, provide pictures representing various holidays (Hallowe'en, Easter, Valentine's Day, Christmas, Canada Day) and ask the students to arrange them in a sequential pattern.

C2/3.1 Have students collect objects of nature from the playground (pebbles, leaves, pine needles, buds, nuts). Model a pattern, using the materials, and ask the students to tell what will come next. Have pairs of children take turns creating and extending patterns. They may wish to glue their patterns on construction paper and display for others to see.

Interview

C3.4 Show the student a pattern and ask him/her to describe it.

C3.5 Show the student a geoboard on which a shape pattern is displayed. Ask the student to describe the pattern.

Paired Activity

C3.6 Ask students to work in pairs to design an action pattern activity to present to their classmates.

Suggested Resources

Young Children Learning
p. 61 Formal and informal practice,
Some children are playing with cars

Interactions - Kindergarten
Unit 4, pp. 122, 138-141
BB - pp. 38-39

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

KSCO: By the end of grade 3, students will be expected to

i) recognize, describe, extend, and create patterns and sequences in a variety of mathematical and real-world contexts (e.g., geometric, numeric and measurement)

SCO: By the end of kindergarten, students will

C4 represent the same pattern in multiple ways

Problem solving should be the central focus of the mathematics curriculum. As such, it is a primary goal of all mathematics activity. Problem solving is not a distinct topic but a process that should permeate the entire program and provide the context in which concepts and skills can be learned. (Curriculum and Evaluation Standards for School Mathematics, NCTM, p. 23)

Elaboration - Instructional Strategies/Suggestions

C4 Kindergarten children should be developing the abilities to recognize, describe, and continue patterns. They should also be learning to represent a pattern in a variety of ways, which is a more complex concept.

Provide a simple pattern such as "snap, clap, snap, clap" and ask the students to use Unifix blocks to represent the pattern; for example, white, red, white, red. Have them share their patterns and discuss the various responses. Ask the students to continue their pattern "trains" of blocks. Encourage them to use other representations for the same pattern (boy, girl, boy, girl; opened book, closed book, opened book, closed book; crayon, pencil, crayon, pencil; red block, green block, red block, green block).

Change the original clapping pattern on subsequent days, encouraging more challenging representations, for example, AABABAABAB.

Have students present their own patterns, which their classmates will represent in some form. Conversely, have students represent a pattern, using materials and ask their classmates to describe the pattern. Example:

> A pattern of 2 boys, 1 girl, 2 boys, 1 girl could be described, among other ways, as "clap, clap, snap, clap, clap, snap" or "two, one, two, one" or "red, red, blue, red, red, blue."

Some materials that can be collected to be used for patterning might include buttons, shells, macaroni, cereal, paper clips, plastic forks and spoons, bottle caps, and jar lids.

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

Worthwhile Tasks for Instruction and/or Assessment

Performance

C4.1 Give a "clap, snap" pattern. Provide a variety of materials for the student and ask that he/she represent the pattern in two different ways.

C4.2 Provide a pattern and ask the student to represent it with an action pattern. The following example might be represented by "clap, clap, snap, clap, clap, snap":

C4.3 Allow the student to select a musical "instrument" and ask that he/she use it to represent a pattern that is provided.

C4.4 Provide the student with a collection of colour tiles. After he/she has developed and described a pattern with the tiles, ask that the pattern be represented in another way, using a different material.

Interview

C4.5 Present the students with the two different action patterns below and ask them to tell which of the two they prefer and why.

- Sit down, stand up, turn around, sit down, stand up, turn around.
- Snap fingers, clap hands, pat knees, snap fingers, clap hands, pat knees.

Suggested Resources

Interactions - Kindergarten
MCL - p. 27

KINDERGARTEN - MEASUREMENT

Shape and Space

General Curriculum Outcome D:

Students will demonstrate an understanding
of and apply concepts and skills
associated with measurement.

GCO D: Students will demonstrate an understanding of and apply concepts and skills associated with measurement.

KSCO: By the end of grade 3, students will be expected to

i) measure and understand basic concepts and attributes of length, capacity, mass, area, and time

SCO: By the end of kindergarten, students will

D1 compare and order objects based on length, capacity, and mass

When students compare objects on the basis of some measurable attribute, that attribute becomes the focus of the activity. (Elementary School Mathematics, p. 293)

Elaboration - Instructional Strategies/Suggestions

D1 It is important, at this stage, that students focus on "what it means to measure," rather than "how to measure with non-standard or standard units."

•Length: Many students' first experiences with measurement involve length. They are often vitally interested in who is taller, which toy car went further, etc.

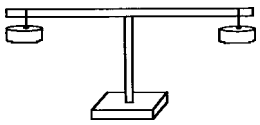
As students become familiar with the various terms associated with length (long, short, wide, tall, high, far), they should have opportunities to compare lengths by measuring both directly (e.g., standing two children back to back) and indirectly (e.g., cutting a string the length of one object and then laying the string along a second). It is important that students have a significant amount of comparison experience prior to using non-standard and standard units for describing length.

•Capacity: Students enjoy filling containers with sand and water to determine their capacities. It is important to provide a wide range of materials, including many sizes and shapes of containers.

Students might explore the effect of pouring the same amount of water into containers of different shapes and sizes. The focus should be on comparison, rather than describing the capacities of individual containers.

•Mass: Students are often interested in the "heaviness" of objects, particularly when they have to move them. Some of the objects of most interest to students in this respect are quite large, and only gross comparisons can be made. However, this interest can be transferred to smaller objects which are amenable to comparison on a pan balance.

If manufactured balances are not available, a variety of homemade pan balances can be created (e.g., cottage cheese containers hung from the ends of pegboard strips attached to a base).



Some interesting measurements students might make include

- comparing structures they have built in terms of height and width
- comparing their heights
- comparing arm lengths
- determining the length of paper strips needed to make frames for pictures
- comparing the capacities of different types of cups, spoons, pails, boxes, bowls
- determining how many cans full of sand it takes to fill a larger jar
- filling containers of the same size and shape with different amounts of water in order to produce different pitches of sound
- comparing the masses of different rocks or different fruits and vegetables

GCO D: Students will demonstrate an understanding of and apply concepts and skills associated with measurement.

Worthwhile Tasks for Instruction and/or Assessment

Performance

D1.1 Provide a coffee mug and a thermos and ask students to predict and test to find which holds more.

D1.2 Ask students to show you something that is long (or wide or high).

D1.3 Ask students to estimate and then determine which of two toys is "heavier" by using a pan balance.

D1.4 Ask the student to find the longest carrot in a bunch.

Observation

D1.5 As students compare the lengths of objects, note

- whether or not they recognize the importance of a base line; that is, comparing by starting both objects at the same place
- whether or not they understand that if A is longer than B, and B is longer than C, then A must be longer than C
- how they handle situations in which direct measurement of length is difficult

D1.6 It is interesting to note whether or not students' predictions about the capacities of containers are affected by

- the height of the container only
- the width of the container only
- both height and width of the container
- the shape of the container
- the familiarity of the container
- the function of the container

D1.7 Observe students as they consider the masses of objects. Note whether or not they

- accurately use terms such as "heavier," "lighter," "heaviest," "lightest"
- consider the shape of an object in predicting its mass
- consider the size of an object in predicting its mass
- consider the material out of which the item is made when they predict its mass
- are familiar with which types of materials are generally "light" or "heavy"

Suggested Resources

Young Children Learning
p. 21 Stretching and curling
p. 24 Throwing and catching
p. 59 Physical graphs
p. 114 Balance scales
p. 124 Measuring
pp. 112-113 Water
pp. 113-115 Sand

Interactions - Kindergarten
Investigation Bklt - pp. 5, 7-8, 12, 14-15, 17-18, 20, 23, 26, 28, 30
Unit 2, pp. 62, 76
Unit 3, p. 105
Unit 4, pp. 121-123, 126-129, 132-136, 142, 144
MCL - pp. 6-7, 9, 12-15, 18-19, 21, 26-27, 29, 31
BB - pp. 34-35, 38-39

Interactions - Kindergarten
Investigation Bklt - pp. 10, 17-18, 28
Unit 4, pp. 121-123, 129, 132-133, 136, 138, 143-144
MCL - pp. 13-15, 24-25

Interactions - Kindergarten
Investigation Bklt - p. 17
Unit 4, pp. 121, 123, 130-133, 137, 142, 144
MCL - pp. 8, 12, 15, 25, 31

GCO D: Students will demonstrate an understanding of and apply concepts and skills associated with measurement.

KSCO: By the end of grade 3, students will be expected to

i) measure and understand basic concepts and attributes of length, capacity, mass, area, and time

SCO: By the end of kindergarten, students will

D2 sequence events

D3 sort items based on measurement attributes

Problem solving should be the central focus of the mathematics curriculum. As such, it is a primary goal of all mathematics activity. Problem solving is not a distinct topic but a process that should permeate the entire program and provide the context in which concepts and skills can be learned. (Curriculum and Evaluation Standards for School Mathematics, NCTM, p. 23)

Elaboration - Instructional Strategies/Suggestions

D2 Students' experiences with sequencing events might include reconstructing prior events or anticipating future ones. Events to sequence could include

- parts of the day
- classroom routines
- home routines (e.g., for going to bed or starting the day)
- seasons
- days of the week
- months of the year (early experiences)
- food preparation
- parts of a story

While some students may be interested in measuring time, using sand or water clocks, the primary focus at kindergarten is on sequencing, not measuring duration. Students should come to recognize that sometimes sequence is important and sometimes it is not.

D3 Students can sort items based on a variety of measurements, including length, capacity, mass, and time.

❒ Possible activities include sorting
- clothing by size (for babies or dolls, for kids, for adults)
- children by hair length (short hair, medium hair, long hair)
- kitchen items by capacity (holds enough for one person, holds enough for a small group, holds enough for a large group)
- "fantasy" items made by the children (for giants, for regular people, for elves)
- same size cannisters (light, medium, heavy)
- "time" pictures such as brushing teeth, reading a book, eating lunch (a few moments, a little while, a long time)

GCO D: Students will demonstrate an understanding of and apply concepts and skills associated with measurement.

Worthwhile Tasks for Instruction and/or Assessment

Performance

D2.1 Ask students to describe the sequence of events in a particular story that was recently read.

D2.2 Ask students to describe the steps, in order, that one would take to decide which of two objects is longer.

D3.1 Provide a variety of tools to a group of students. Ask them to determine which they would label small, which medium and which large. Ask how they decided.

D3.2 Read the story "The Three Bears." Ask students to find appropriate bowls for Mama Bear, Papa Bear, and Baby Bear.

D3.3 Ask students to choose a cup that they would call large and one they would call small.

Observation & Interview

D2.3 The contexts in which students are comfortable sequencing events may vary. Determine how the following variables affect a student's ability to sequence events:

- the degree of familiarity of the child with the situation
- the interest level of the child in that particular situation or activity
- the recency of a related experience for that child

D2.4 Ask: Does it matter in which order you

- brush your teeth, eat your breakfast, wash your hands?
- swing on a swing, play on the jungle gym, slide down a slide?
- put on your shirt, put on your shoes, put on your socks?

D3.4 Observe students as they sort objects based on measurement. Note whether or not they

- can make fine distinctions as well as gross ones
- always sort into two groups or can sort into a number of groups
- can resort the same items based on different measurement characteristics

Suggested Resources

Young Children Learning
p. 54 Verifying memory by repeating experience
pp. 63-64 Temporal relations

Interactions - Kindergarten
Investigation Bklt - pp. 10, 22
Unit 4, pp. 120, 130-137, 144
MCL - pp. 12-13, 25
BB - pp. 36-37

Young Children Learning
pp. 57-58 Classifying

Interactions - Kindergarten
Investigation Bklt - p. 5
Unit 4, pp. 134-137, 142-143
MCL - pp. 9, 13-14, 16, 19, 25-28

Shape and Space

General Curriculum Outcome E:

Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

KSCO: By the end of grade 3, students will be expected to

i) explore and experiment with geometric shapes and relationships (including the orientation and perspectives of objects)

SCO: By the end of kindergarten, students will

E1 develop spatial sense, including position-in-space and the language associated with it

Informal geometry is aimed at development of 'spatial sense' . . . This spatial sense grows and develops over the entire time children are in school. Students should have several in-depth geometric experiences every year. (Elementary School Mathematics, p. 324)

Elaboration - Instructional Strategies/Suggestions

E1 Position-in-space

Position-in-space perception is the ability to determine the relationship of one object to another and to the observer. Because children perceive themselves to be spatially the centre of their universe, they naturally perceive objects in relation to themselves. Objects are above, below, beside, in front of, and behind them. Children who have difficulty with position-in-space perception are likely to experience reversals in reading and writing, and struggle with mathematics as well.

Children at this age are developing mental maps of the areas familiar to them as they explore in and around their homes and their schools. Their knowledge is limited by their experiences; therefore, it is important to provide opportunities for exploration of space – going over, under, and between objects, and moving objects to observe from different perspectives. The gymnasium provides a perfect venue for children to explore space.

Language required to describe positions in space must be developed. Encourage the use of spatial language in connection with daily routines. Provide students with opportunities to follow, and to give, directions using spatial language such as "below," "above," "between," "beside," "behind," "through," "to the right," and "to the left." While these opportunities need to be provided, not all students will be readily able to differentiate between "right" and "left" at this age.

- ❒ Have students construct a "town" with building blocks. Ask them to direct a fellow student through the town, using spatial language. This process should first be modelled by the teacher. With practice students will use increasingly more terms. Directions might include:
  - Drive over the bridge. Turn right.
  - Go under the bridge and through the tunnel.
  - Turn left. Drive down the street between the park and the mall.
  - Go to the last house on the right at the end of the street.
- ❒ Extend self/object relationships to object/object/self relationships. Give directions to students, using spatial language terms; for example:
  - Put one blue block beside the red one.
  - Place another blue block behind the red one and a green one on top of each of the blue ones.

  Ask students to compare their constructions with those of their classmates. Do any differ? Can there be more than one right answer? Encourage discussion and ask students to provide directions for other constructions.
- ❒ Have children create "maps" in sand or with blocks, paints, or crayons. They might map the classroom, the school, playground, familiar buildings, or routes to school. Observe global accuracy, attention to detail, consideration of relative distances and positions in their maps.

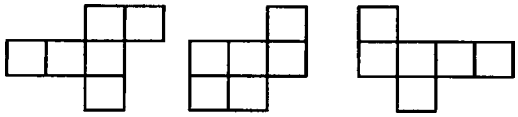
GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

Worthwhile Tasks for Instruction and/or Assessment

Performance

E1.1 Set up an obstacle course and have the student follow directions provided by you or a classmate. Include a variety of appropriate spatial language.

E1.2 Make several different shapes by fastening (up to seven) linking blocks together. Ask the students to duplicate the shapes; for example,



E1.3 Show a 3-D construction of different-shaped building blocks and ask the student to duplicate it for you.

E1.4 Give directions for a student to follow, using both positional and geometric language; for example:

One blue triangle is beside a red circle. Another blue triangle is above the circle. There is a yellow rectangle between the red circle and a green square. Ask: What does the shape look like? Can there be more than one shape? (Repeat the directions and encourage dialogue.)

Give directions for a student to follow in constructing a 3-D shape; for example: "Place one yellow block (hexagon) on top of another and put a tower of four orange blocks (square) to the right of the yellow blocks. Place two red blocks (trapezoid), one in front of and one behind the orange tower."

E1.5 Make a yarn loop. Ask the student to put four counters in the loop, five outside and two on the loop.

Interview

E1.6 Ask the student to tell you what things in the room he/she could hide in or behind; stand on, in, or under; jump over or climb under. Extend this to a discussion of where house or classroom pets (or larger animals) could go within the classroom.

Paired Presentation

E1.7 Ask pairs of students to work together designing a "neighbourhood" in the sand box or with building blocks. Have them select students to tour the neighbourhood, following directions that they provide. Encourage them to use spatial language.

Note: Students should be encouraged to work with puzzles regularly. These provide practice for all the spatial skills. It is important to provide puzzles that span a wide range of complexity; some children come to kindergarten with a great deal of experience while others have had no experience at all. Selected puzzles should challenge all students.

Suggested Resources

Young Children Learning
p. 54 Verify memory by repeating experience
pp. 62-63 Spatial concepts

Interactions - Kindergarten
Investigation Bklt - pp. 6, 27
Unit 1, p. 49
Unit 3, p. 97
MCL - p. 7

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

KSCO: By the end of grade 3, students will be expected to

i) explore and experiment with geometric shapes and relationships (including the orientation and perspectives of objects)

SCO: By the end of kindergarten, students will

E2 develop spatial sense, including eye-motor coordination

Elaboration - Instructional Strategies/Suggestions

E2 Eye-motor coordination

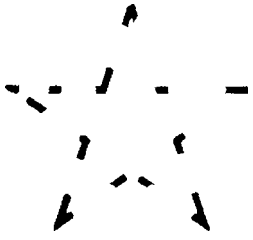
Children's early experiences within their environment are mostly spatial. They need experiences that foster the development of visual memory, discrimination and perception of spatial relations. One goal of the mathematics program is to extend these experiences through activities that develop eye-motor coordination. Eye-motor coordination is the ability to coordinate vision with body movements during various activities. Students are unable to fully concentrate on learning experiences if their visual-motor coordination has not become proficient and automatic.

Children's eyes direct the movement of the feet when they run, jump, kick a ball, or step over an obstacle. The eyes work with the body to perform such tasks as getting dressed, cutting out a figure, or packing a lunchbox. It is through practice that skills in eye-motor coordination develop to the point that the child is not concentrating on the motor skills; the skill is habitual, and concentration can be directed to new skills.

The many hands-on activities found in all kindergarten classes help to develop eye-motor skills for use in all areas of students' lives. Geometric activities involving more fine-motor spatial skill include
- tracing over dots
- joining broken lines
- making shapes on geoboards
- joining dots on geopaper (including slanted and curved lines, as well as vertical and horizontal ones)
- refining a sense of direction through tracing figures and filling in regions (which could include colouring)
- drawing within guidelines (including narrow, straight, curved, and angled paths)
- constructing 2- and 3-D shapes, both from oral directions and from models

Activities such as these strengthen position-in-space as well as eye-motor ability.

❒ Ask the student to connect the broken lines to make a shape.



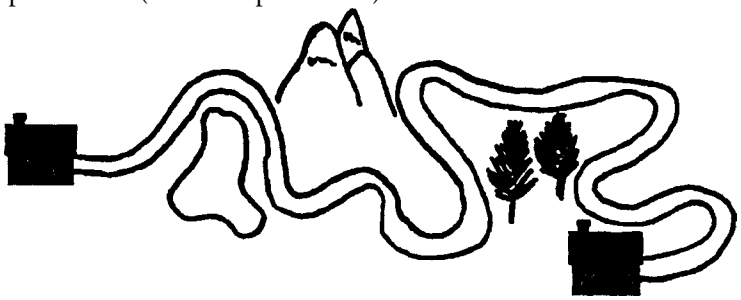
Among any incoming group of kindergarten students, development of eye-motor coordination skills varies widely. It is important to assess the developmental level of the students and to modify activities accordingly. For example, some students will be able to stretch elastics around pegs with relative ease, while others will find it to be a difficult task and require more practice.

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

Worthwhile Tasks for Instruction and/or Assessment

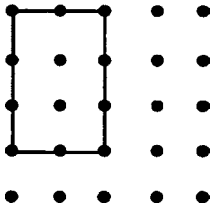
Performance

E2.1 Ask the student to use a pencil/crayon to trace along a path that has been provided. (See example below.)



E2.2 Have the student trace along a designated path in sand and ask him/her to describe the path being followed.

E2.3 Show the student a simple shape that has been drawn on geopaper and ask him/her to duplicate it on a geoboard. (See example at right.)



E2.4 Have the students place a connecting cube on the top left-hand peg of a geoboard and one on the bottom right-hand peg. Have them imagine that the geoboard is a body of water and the pegs are stones on which they can hop. Ask them to use yarn to illustrate a path from one "house" to the other, hopping on the stones (pegs). Encourage the students to display their geoboards and to find as many different paths as they can. (As an extension, students may wish to record paths on 5 x 5 dot paper.)

E2.5 Ask the student to fill a region (such as that illustrated below) with the fewest pattern blocks that he/she can.

E2.6 Ask the student to describe how to make a shape (a triangle, for example) on a geoboard. Follow the student's directions exactly as you build a shape on an overhead geoboard.

Observation

E2.7 Observe the student as he/she colours in a given shape.

Suggested Resources

Interactions - Kindergarten
Investigation Bklt - p. 6
Unit 3, pp. 97, 111

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

KSCO i) By the end of grade 3, students will be expected to

i) explore and experiment with geometric shapes and relationships (including the orientation and perspectives of objects)

SCO: By the end of kindergarten, students will

E3 sort and build with 2-D and 3-D shapes

Sorting or classifying shapes using models is a good way to introduce geometric ideas . . . . When students omit shapes from a category they have identified or fail to create a category you hoped they would discover, it is a clue to their perceptual thinking. (Elementary School Mathematics, p. 328)

Elaboration - Instructional Strategies/Suggestions

E3 The block centre, or corner, is a most important place for students to regularly explore and experiment. As they make their constructions, they begin to learn, often through trial and error, about the attributes of the various shapes. They can identify those that stack, those that roll, those that stack and roll, and those that are stable and make sturdy foundations for constructions. It is through these investigations that students are able to learn the characteristics and properties of shapes.

Children should have many opportunities to sort shapes in the context of everyday activities (e.g., when putting blocks away in the proper places). With experience, students learn that each shape has many attributes and one shape may fit in more than one category. For example, the ramp-shaped block possesses both rectangular and triangular faces, so would fit with either shapes with triangular faces or shapes with rectangular ones.

Sorting criteria that students might use include number of faces, thickness of the shape, and whether it rolls and/or stacks, as well as non-geometric criteria such as colour, function, and texture.

- ❒ Give pairs of students a mixed set of attribute or logic blocks. Ask them to sort the blocks and to explain their sorting rule. Encourage them to resort them in other ways. (Some may want to begin sorting by placing them properly in their containers that have indentations for each shape.)

As children engage in building activities, they have many opportunities to explore geometric concepts such as how the same blocks can be arranged in different ways. Which blocks make the best bases for structures? Which are most stable? How should different blocks be arranged for strength? What blocks can be substituted for others?

Children's exploration and development are enhanced by the teacher's interest and questions, space and time to build and elaborate, opportunities to discuss their constructions, and permission to leave them standing for free play or additions.

- ❒ Have students build imaginary buildings, monsters, or machines from 2-D shapes or 3-D materials such as boxes, cans, balls, paper cylinders, and cones.

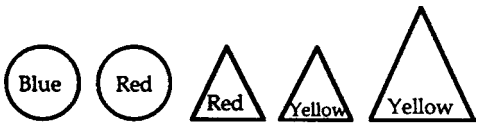
GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

Worthwhile Tasks for Instruction and/or Assessment

Performance

E3.1 Have one student create a structure and ask his/her partner to create one that is quite different and to explain the differences.

E3.2 Ask students to build difference trains, using attribute blocks. For example, in the train below, neighbouring blocks differ by one attribute.



E3.3 Give the student a collection of 3-D shapes and ask him/her to sort them in some way and to explain the sorting rule.

Observation/Interviews

E3.4 It is useful to note whether or not the children
- show awareness of the shapes used in structures such as bridges, garages, roads and road signs, etc., and use them in their own constructions
- use geometric terminology to describe the shapes
- consider the function of particular shapes in particular situations (e.g., a curved block for a bend in the road)
- comment on the similarities and differences within a set of geometric materials
- discover which shapes contain other shapes within them

E3.5 As students sort shapes, observe whether or not they
- can resort the same group of shapes in different ways (e.g., recyclables by brand, shape, size, materials, etc.)
- use both traditional and unique sorting approaches (e.g., by shape, by "fanciness" of the shape, or by function)
- use a variety of attributes of shapes for sorting
- are affected by the orientation of the shapes

Suggested Resources

Young Children Learning
pp. 122-125 Blocks
p. 124 Shapes

Interactions - Kindergarten
Investigation Bklt - pp. 6, 20
Unit 1, p. 38
Unit 2, p. 71
Unit 3, pp. 99, 104-105, 107
Unit 4, p. 123
Unit 5, p. 150
MCL - pp. 7, 10-11, 22-23, 27
BB - pp. 26-27

Interactions - Kindergarten
Investigation Bklt - pp. 16, 19, 28-29
Unit 2, p. 82
Unit 3, pp. 104, 108-111, 114-116
MCL - pp. 7, 17, 20
BB - pp. 28-31

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

KSCO: By the end of grade 3, students will be expected to

i) explore and experiment with geometric shapes and relationships (including the orientation and perspectives of objects)

SCO: By the end of kindergarten, students will

E4 pattern with 2-D and 3-D shapes

Elaboration - Instructional Strategies/Suggestions

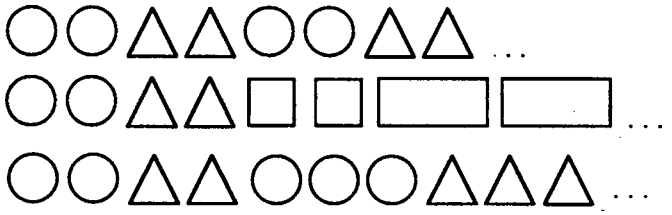
E4 Early patterning activities might include students copying patterns that have been set up for them. (See also SCO C1.)

❒ Lay out on a table a pattern such as that shown at right. Ask the student to make the same pattern underneath.

(It is important to recognize that this will not ensure that they are able to discern the pattern; they may only be imitating the arrangement.) Encourage the student to verbalize - "two triangles, one square, two triangles,..."

❒ Begin a pattern (such as that shown below) and ask the students to continue it.

❒ Encourage students to continue patterns in other ways.

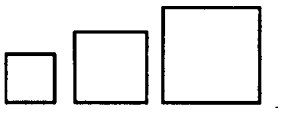


❒ Patterns involving shape might focus on

- orientation - for example,

- number of sides - for example,

- growth - for example,



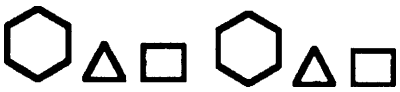
GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

Worthwhile Tasks for Instruction and/or Assessment

Performance

E4.1 Give the student a collection of 3-D shapes and ask him/her to use some or all of them to create a pattern and to describe it.

E4.2 Ask the student to use materials to reproduce a given pattern, for example,



E4.3 Have the student use coloured 2-D shapes to create a pattern on the overhead. Ask him/her to describe the pattern to the class.

E4.4 Have the student continue the pattern.

Interview

E4.5 Show the student the pattern below and ask him/her to describe it.

Ask: If you were to include rectangles in the pattern, how many would you need?

Suggested Resources

Young Children Learning
p. 18 Observing
p. 21 Spatial awareness
p. 114 Textures and patterns

Interactions - Kindergarten
Unit 1, pp. 60-61
Unit 3, pp. 96-97, 99, 112-116
MCL - pp. 16, 22
BB - pp. 32-33

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

KSCO: *By the end of grade 3, students will be expected to*

ii) describe, model, draw, and classify 2- and 3-D figures and shapes

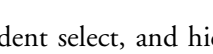
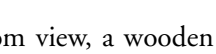
SCO: By the end of kindergarten, students will

E5 recognize, name, describe, and compare 3-D shapes (including sphere, cylinder, cone, and cube) and 2-D shapes (including square, triangle, circle, and rectangle)

Elaboration - Instructional Strategies/Suggestions

E5 Children come to school having had experience with many 3-D shapes; in fact, their most common experiences are those involving three-dimensional, rather than two-dimensional, shapes. Early school experiences should include sorting 3-D shapes and describing how they are alike and how they differ (smooth sides, sharp corners, will roll, will fit together to make a bigger one of the same shape, etc.).

As students are asked to describe shapes, it becomes necessary for them to recognize that lines come together to form a "point." Students should not be required to call them "angles"; in fact, "corner" is the commonly used term. The important concept here is that students begin to understand the attributes of the various shapes with which they work.

- Make "footprints" in the sandbox using one face of a 3-D shape. Ask the students to select from a number of shapes the one that made the footprints. Invite students to create their own "mystery footprints." Explore "end-over-end" footprints through the sand; for example, a  might look like  or  , depending on how it is tumbled.
- Have a student select, and hide from view, a wooden block. Ask him/her to describe the block to the class, one hint at a time, to see if they can guess which one was selected (or have the classmates guess by asking questions without using a 3-D shape name).

Provide many opportunities for students to explore solids. They should be encouraged to talk about their activities as they sort and build with the materials. Both everyday objects and specialized blocks should be used to develop an awareness of the attributes of 3-dimensional solids. They might consider such questions as whether it makes a good base on which to build.

- Activities in which students might engage include
  - sketching a blueprint of a building before it is put away
  - comparing building blocks with similar shapes but different scales (e.g., Lego and Duplo)
  - guessing a shape in a bag by touch alone
  - playing "I Spy" with a focus on shape

It is important to begin to provide activities to develop the students' visual memory. Visual memory is the ability to recall objects no longer in view.

- Show students (for about 10 seconds) a shape on an overhead or drawn on a card. Have them reproduce it on plain paper. Ask them to explain how they were able to remember the shape. Compare their shapes with the original. (Select 2-D shapes they should recognize, such as square, triangle, circle, and rectangle.)

Note: At this stage, children recognize and name 2-D and 3-D shapes based on global, visual characteristics or attributes. They consider the overall appearance (not specific properties) when naming, sorting, and comparing figures.

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

Worthwhile Tasks for Instruction and/or Assessment

Performance

E5.1 After one student has created a structure, ask another to create a structure which is quite different and to explain the differences.

E5.2 Provide a number of grocery store containers. Ask the student to sort them and to explain the sorting rule. Have the student sort in a different way.

E5.3 Show the student (for about 10 seconds) a construction made from a combination of 3 or 4 pattern blocks. Ask him/her to use blocks to reproduce the construction from memory.

E5.4 Cut out a number of 2-D shapes from cardboard. Place them in a "feely bag" and provide a sample of each on a table for the student to use as a guide. Reach in the bag to touch a shape and give the student the first clue to identify it. Encourage the student to develop a plan for guessing what shape has been selected. Continue to provide clues until the student is able to accurately determine what shape is being described.

E5.5 Ask each member of a group of students to make a 4-sided shape on a geoboard. Have them categorize their shapes and place their geoboards on a table or the floor to create a graph showing this categorization. (It may be worthwhile to extend this to a class graph.)

E5.6 Use masking tape to form large outlines of 2-D shapes on the floor. Invite the students to walk (hop, crawl, skip or jump) on the tape around the shapes and to talk about the sides and corners, comparing them with others.

Interview

E5.7 (Although shapes that are "somewhat rectangular" or "somewhat spherical" are often referred to as being rectangles and spheres, it is important not to give a false impression to students. Positive exemplars must be used. A ball is a sphere; a grapefruit is "almost" a sphere. A can is a cylinder, a paper cup is "almost" a cylinder. The goal is to create a vivid image in children's minds.) Show the student a picture of a shape that is "almost" a rectangle. (See examples below.) Ask: "Is this a rectangle? Why or why not? How can it be made into a rectangle?

Paired Presentation

E5.8 Provide pairs of students with a collection of toys that one might find in a toy box. These might include balls of various sizes, several building blocks, boxes containing games, cylindrical containers holding games (e.g., pick-up sticks), and building materials (e.g., linking blocks, Lego). Ask the students to sort these according to their own rules.

Suggested Resources

Young Children Learning
p. 121 Base materials
pp. 122-125 Blocks

Interactions - Kindergarten
Investigation Bklt - pp. 6, 9, 20, 22
Unit 3, pp. 96-99, 102-116
MCL - pp. 10-11, 21
BB - pp. 26-29, 30-31

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

KSCO: By the end of grade 3, students will be expected to

iii) investigate and predict the results of combining, subdividing, and transforming shapes

SCO: By the end of kindergarten, students will

E6 build 2-D shapes, using structured materials

E7 subdivide and change shapes

Problem solving should be the central focus of the mathematics curriculum. As such, it is a primary goal of all mathematics activity. Problem solving is not a distinct topic but a process that should permeate the entire program and provide the context in which concepts and skills can be learned. (Curriculum and Evaluation Standards for School Mathematics, NCTM, p. 23)

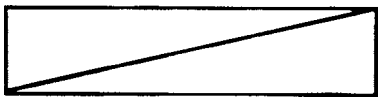
Elaboration - Instructional Strategies/Suggestions

E6 Students in kindergarten enjoy playing with 2-D materials such as pattern, attribute, and logic blocks. They should be encouraged to put shapes together to make larger shapes and also to take apart creations that are already made.

- ❒ Students might be asked to see what animals they can make, using a group of pattern blocks. (Some children may be able to count the number of blocks that were used.)
- ❒ Have students reach in a bag to select eight pieces from a collection of tangram pieces. Ask each student to create a figure from these pieces and encourage them to draw background features to complete their pictures.
- ❒ Ask students to each work with a partner. Before they begin, have them agree on the number of attribute blocks they will use to create a design. One student makes the design; the other replicates it. Have them make another with roles reversed.
- ❒ Have students pick a shape (a triangle, for example) and ask them to build a short one, a tall one, a fat one, and a thin one. Ask them to talk about their shape family. Are they all triangles?
- ❒ Have students build with straws and pipe cleaners, toothpicks and marshmallows, or modelling clay.

E7 Provide opportunities for students to divide regular shapes into two or more parts. A triangle might be cut into smaller triangles; a rectangle can be cut into many smaller rectangles; a circle can be cut into two semi-circles, but not two circles. Students can construct a bigger rectangle by combining rectangular-shaped attribute blocks. Can they make a bigger square? a bigger triangle? a bigger circle?

When possible, make students aware that they might start with one shape (e.g., two triangles), but end up with a totally different one (such as a rectangle).



- ❒ Challenge students to make a shape (that they can identify) from two or more different shapes. For those who are able, have them trace around their shape parts. (A square, for instance, can be made of two, three, or more triangles.) Provide students with cut-out shapes of various sizes and ask them to explore different ways of putting them together to make a new shape.

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

Worthwhile Tasks for Instruction and/or Assessment

Performance

E6.1 Ask students to put together four pattern blocks to see what arrangements they can make. They might then draw a picture of, or trace, their creations.

E6.2 Show the student a 2-D shape made of pattern (attribute, logic) blocks and ask him/her to replicate it.

E6/7.1 Give students an outline and ask them to fill it in with pattern blocks. Challenge them to find additional ways of filling in the outline.

E7.1 Ask the students to select a number of pieces of the same shape from the pattern blocks. Challenge them to use the blocks to make a larger version of the same shape. Can they make a larger square, using the smaller orange squares? a larger triangle, using the small green triangles?

Observation/lnterview

E6.3 Observe children as they work with pattern blocks to see how easily they predict what shapes will fit beside various others when making a design.

E6/7.2 Give the students a set of cut-out shapes and ask them to combine two or more to make a different shape.

Observe the students as they work.

- Are they persistent?
- Are they willing to take risks?
- Do they recognize when a shape does not fit and make adjustments?
- Are they attempting to assemble particular shapes or simply exploring to see what comes together?

Encourage them to talk about the assignment.

Suggested Resources

Interactions - Kindergarten
Investigation Bklt - pp. 4, 6, 9, 13, 19
Unit 3, pp. 96-97, 99, 113, 115-116

Interactions - Kindergarten
Investigation Bklt - p. 19
Unit 3, p. 113

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

KSCO: By the end of grade 3, students will be expected to

iii) investigate and predict the results of combining, subdividing, and transforming shapes

SCO: By the end of kindergarten, students will

E8 make transformations of figures and shapes

Elaboration - Instructional Strategies/Suggestions

E8 Kindergarten students will begin to explore shapes that have been moved to new positions. It is not necessary for the students to use the terms "flip," "turn," and "slide," but some may model the teacher's language when he/she uses such directions as "Slide your cookie cutter up" or "Flip your cutout over and trace the new shape." It is important that students recognize that the shape stays constant regardless of the flipping, sliding or turning. Some students have difficulty drawing or tracing a shape repeatedly so that it clearly looks the same, simply repositioned. These students might use stickers to create their turn and slide patterns.

- ❒ Provide wallpaper and/or wrapping paper for the students to find patterns that involve shapes that are repeated, either by sliding or by flipping to a different orientation.
- ❒ Students would enjoy making potato pattern prints with paint, or cookie-cutter patterns in playdough or cookie dough.
- ❒ Ask students to find samples of patterns in clothing and encourage them to discuss the pattern formation.
- ❒ Provide templates (or have students make their own) and ask students to create slide and flip patterns to decorate areas in the classroom (such as bulletin boards).
- ❒ Have students make their own wrapping bags by decorating paper bags with paint patterns, using a combination of slides and turns.

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

Worthwhile Tasks for Instruction and/or Assessment

Performance

E8.1 Ask the student to create and describe a flip or slide pattern in the sand.

E8.2 Ask the student to create and describe a flip or slide pattern, using attribute blocks.

E8.3 Have the student create a slide and turn pattern in the paint corner, using, for example, a template of a pumpkin, poppy, valentine heart, or other seasonal object.

E8.4 Provide stickers with designs (such as happy faces). Ask students to create patterns with the stickers illustrating slides or turns.

E8.5 Provide a piece of "checked" fabric. Have students look for slides and flips.

Interview

E8.6 Show the student a number of triangles, all drawn from the same template but representing slides, flips, and turns. Ask: What can you tell me about these triangles? Are they the same or are they different? Provide students who are not convinced that they represent the same triangle in different orientations with the template and ask that it be used to test if the triangles are the same or different.)

E8.7 Use 2-coloured counters. Ask the student to create a pattern by flipping every other counter. Have him/her explain the colour pattern.

Suggested Resources

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

KSCO: By the end of grade 3, students will be expected to

iv) relate geometric ideas to number and measurement ideas and recognize and apply geometric principles in real-world situations

SCO: By the end of kindergarten, students will

E9 recognize familiar shapes occurring in the environment

Geometry helps people have more complete appreciation of the world in which they live. (Elementary School Mathematics, p. 325)

Elaboration - Instructional Strategies/Suggestions

E9 As kindergarten children work with 2-D and 3-D shapes in the classroom, it is important that they be encouraged to relate their findings to the world. Children often fail to "see" the parts that make up the whole. It is important to design activities that will direct the students' attention to detail so they actually "see" the shapes within other shapes.

- ❒ Invite students to collect objects, to cut out pictures, or to make drawings of familiar shapes as they find them in their environment.
- ❒ The outside of the buildings in which they live offer many examples of both 2-D and 3-D shapes that students can report on and draw.
- ❒ Ask students to find containers of different shapes in their kitchen cupboards and to conjecture as to why these were selected over other shapes.
- ❒ Encourage students to look for odd-shaped containers that they could share with the class.
- ❒ Ask students to collect objects of different shapes that they find on the playground.
- ❒ Give students a set amount of time to walk around the school in search of 4 examples of a particular shape. Ask them to record their findings in writing or with pictures.
- ❒ Ask students who live near a bridge to make a sketch of it. Ask those who do not have access to a bridge, to find a picture of one. Encourage discussion on the construction. This could lead to a more in-depth study of bridges – Where do they start to build a bridge? What about covered bridges?
- ❒ Provide for the class a large grid divided into four columns headed "square," "rectangle," "triangle," and "circle." Divide the class into four groups. Give them small pieces of paper and ask them to find and sketch an object that would fit under the column designated to them. Create a picture graph of these shapes. Once they understand the activity, they could create one of their own.

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

Worthwhile Tasks for Instruction and/or Assessment

Performance
E9.1 Ask pairs of students to work together to select and cut out pictures of 3-D shapes. Have them paste their pictures on a class graph that includes spheres, cylinders, cones and cubes.

Interview
E9.2 Ask: What blocks would you select to build a wall around a building? Explain why you selected these blocks. What shapes would you select to make a tree house? What kind of tree would you need?

E9.3 Ask: Why is the shape of shoes closer to a rectangle than a circle?

E9.4 Ask: Why do some people think of mountains as triangles?

Paired Discussion
E9.5 Ask pairs of students to discuss why they think classroom walls are in the shape of rectangles. What other shape might they be? Is there any regular shape they could not be? Why or why not?

E9.6 Provide a catalogue of building materials for the students. Have them explore a section (e.g., the section on windows) to discover what shapes (of windows) are sold.

Portfolio
E9.7 Ask the students to make a shape book in which they draw and/or paste pictures of objects that are a particular shape (e.g., a circle).

Presentation
E9.8 Have students select shapes from the block corner to construct a model of a dog house and a dog run. When it is completed, encourage them to talk about their creations and to provide reasons for their designs (the kind/size of the dog, sleeping room, consideration of cold weather, size of model in relation to an actual dog house, etc.).

Suggested Resources

Young Children Learning
p. 63 Extending vocabulary

Interactions - Kindergarten
Investigation Bklt - pp. 6, 20, 22, 28
Unit 3, pp. 96-99, 102, 107, 114-115
BB - pp. 26-27

KINDERGARTEN - DATA

Data Management and Probability

General Curriculum Outcome F:

Students will solve problems involving the collection, display, and analysis of data.

GCO F: Students will solve problems involving the collection, display, and analysis of data.

KSCO: By the end of grade 3, students will be expected to

i) collect, record, organize, and describe relevant data

SCO: By the end of kindergarten, students will

F1 collect and organize data about issues of personal interest

One of the most important rules to follow in conducting graphing and statistics activities is to let students gather their own data. (Elementary School Mathematics, p. 391)

Elaboration - Instructional Strategies/Suggestions

F1 To make sense of their world, young students often find themselves collecting and organizing data, either verbally, pictorially, or in charts.

Students often imitate the pictorial data organization schemes which they observe adults use (e.g., some form of tallying), but should be encouraged to develop their own schemes as well.

❒ Some activities in which students might engage include
- keeping track of birthdays in the class
- keeping track of classroom tasks that they have performed
- creating an inventory list in one of the centres
- surveying classmates for eye colour
- using hula hoops to sort footwear into various categories (e.g., those with laces, buckles, velcro)
- organizing a set of pumpkins using various criteria

❒ Ask a student to plan snack time for the next day. Have him/her report his/her classmates' selections of two different snacks.

❒ Ask the students to find out whether their classmates would prefer to be older, younger, or their present age.

❒ Ask the students to keep track of the weather for the week/month and report their findings.

❒ Ask students to collect empty (washed) juice and milk cartons from the class over a two-day period. Have them use the cartons to construct a real graph.

Note: Many of these activities are not confined to only collecting and organizing data. This reflects the fact that collecting and organizing are generally best taught in real contexts that also lend themselves to displaying and interpreting data.

GCO F: Students will solve problems involving the collection, display, and analysis of data.

Worthwhile Tasks for Instruction and/or Assessment

Performance

F1.1 Ask the student to find out how many children want apple juice at snack time and how many want orange juice.

F1.2 Ask a student to keep a record of how many pictures he/she has painted.

F1.3 Ask a student to decide how to organize a list that will tell the types of shoes the children in the class wear.

Observation & Interview

F1.4 Because organizing data is such a natural part of the classroom experience, there will be many opportunities to observe students engaged in such tasks. You may wish to note whether or not students

- prefer verbal or pictorial forms of organization
- use a traditional type of tally scheme
- attempt to predict the results before data is organized
- choose to tape record data that is gathered orally
- keep track of their data sources to ensure that they do not duplicate or omit information

F1.5 Ask the student to tell you the number of sheets of paper that will be needed so that each person in the group will get two.

Suggested Resources

Young Children Learning
p. 45 Use children's ideas
p. 51 Name tags
p. 67 Recording, Tallying, Symbols

Interactions - Kindergarten
Investigation Bklt - pp. 7, 11, 13-14, 17, 21, 24
Unit 2, pp. 68-70, 74-91
MCL - pp. 7, 15, 17, 21, 25
BB - pp. 20-23

GCO F: Students will solve problems involving the collection, display, and analysis of data.

KSCO: By the end of grade 3, students will be expected to

ii) construct concrete and pictorial displays of relevant data

iii) read and interpret displays of relevant data

SCO: By the end of kindergarten, students will

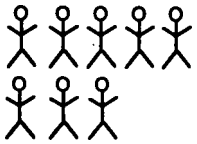
F2 form and interpret "people" graphs

F3 interpret and create real and picture graphs

Bar graphs are one of the first ways to group and present data and are especially useful in grades K to 3. At this early level, bar graphs should be made so that each bar is made of countable parts such as squares, objects, or pictures of objects. No numeric scale is necessary. (Elementary School Mathematics, p. 392)

Elaboration - Instructional Strategies/Suggestions

F2 The most basic type of real graph is a "people" graph, in which the children themselves form the graph.



It is important initially to allow children to form lines on their own. Only then will they learn the importance of all "lines" starting at the same level and of matching students in the "lines" in some form of one-to-one correspondence.

Eventually, it is helpful to use some form of graphing mat on which each student stands in one box. If the children tape their name tags to their boxes before stepping out, they will be able to view the graph as a whole.

❒ Students might graph
- children wearing various colours of T-shirts
- a comparison of children with missing teeth compared to those with all their teeth

F3 Real and picture graphs are bar graphs made of actual materials (such as sneakers, apples, caps, etc.) and pictures/drawings/cut-outs of objects (such as footprints, cars, etc.), respectively. (Note: The "people" graph of SCO F2 is an example of a real graph.) At this early stage, since each bar is made of countable parts, no numeric scale is needed.

❒ Students might wish to create or interpret graphs regarding
- the number of each type of block they used in a tower
- the favourite books of students in the class
- buses on which students travel to school
- the colours of the houses in which students live
- favourite kinds of apples
- the colour of students' hair or eyes
- first or last initial
- the weather

Note: Since it is easier for young children to understand real and picture graphs, it is important for them to create graphs with actual objects and pictures before moving on to symbolic bar graphs in grade one.

GCO F: Students will solve problems involving the collection, display, and analysis of data.

Worthwhile Tasks for Instruction and/or Assessment

Performance

F2.1 Ask students to form into lines in a way that will show how many more children are wearing high top sneakers than other sneakers.

F3.1 Ask students to use pictures to show the different numbers of toy vehicles in a class collection.

Observation & Interview

F2.2 Observe children to see if they naturally consider "people" graphs as a way to determine which of two groups has more people.

F2.3 As the children use "people" graphs, note whether or not they
- pay attention to lining up children one-to-one
- consider their own placement in the graph, if they are the ones outside of the graph doing any counting or observing
- can handle graphs involving more than two categories

F3.2 As students create picture graphs, note whether or not they
- use appropriate illustrations
- ensure that the different items in the graphs illustrate a one-to-one correspondence

F3.3 As students interpret graphs, observe whether or not they
- are comfortable with both horizontal and vertical arrangements
- note a variety of relationships suggested by the graph (where appropriate)
- question the validity of the data (where appropriate)

Suggested Resources

Young Children Learning
p. 58 First use real objects
pp. 58-59 Next transition stage

Interactions - Kindergarten
Unit 2, pp. 68, 74-75, 82-85
MCL - pp. 6, 16

Young Children Learning
pp. 58-60 Graphing
p. 124 Measuring

Interactions - Kindergarten
Investigation Bklt - pp. 8, 11-12, 18, 21, 23-24, 31
Unit 1, pp. 46, 58-59
Unit 2, pp. 68-70, 79-86, 90-91
Unit 5, p. 149
MCL - pp. 6, 8, 16-17, 20, 22-24, 27, 31
BB - pp. 22-25

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