Atlantic Canada Mathematics Curriculum

New Brunswick
Department of Education
Educational Programs & Services Branch

New Nouveau Brunswick

CURRICULUM

Mathematics

Grade 1

2001

Additional copies of this document (Grade 1) may
be obtained from the Instructional Resources Branch.
Title Code (843860)

Ce document est également disponible en français
auprès des Ressources pédagogiques.
Code du Titre (843910)

Acknowledgements

The Departments of Education of New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island gratefully acknowledge the contributions of the following groups and individuals toward the development of the entry-grade 6 mathematics curriculum guides:

- The regional mathematics curriculum committee, current and past members, include the following:

New Brunswick

John Hildebrand, Mathematics Consultant, Department of Education

Joan Manuel, Mathematics/ScienceSupervisor, School District 10

Nova Scotia

Ken MacInnis, Elementary Teacher, Sir Charles Tupper Elementary School

Richard MacKinnon, Mathematics Consultant, Department of Education and Culture

David McKillop, Mathematics Consultant, Department of Education and Culture

Newfoundland and Labrador

Patricia Maxwell, Mathematics Consultant, Department of Education

Sadie May, Mathematics Teacher, Deer Lake-St. Barbe South Integrated School Board

Donald Squibb, Mathematics Teacher, St. James Regional High School

Prince Edward Island

Clayton Coe, Mathematics/Science Consultant, Department of Education

Bill MacIntyre, Elementary Mathematics/Science Consultant, Department of Education

- The Elementary Mathematics Curriculum Development Advisory Committee, comprising teachers and other educators in New Brunswick, lead province in drafting and revising the guides
- The teachers and other educators and stakeholders across Atlantic Canada who contributed to the finalization of the entry-grade 6 mathematics curriculum guides

Table Of Contents

Introduction

Grade 1

Introduction

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," and they 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.)

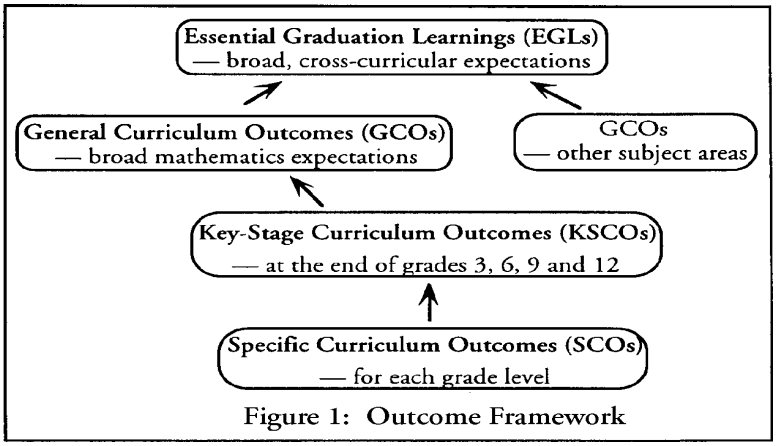


Figure 1: Outcome Framework

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.

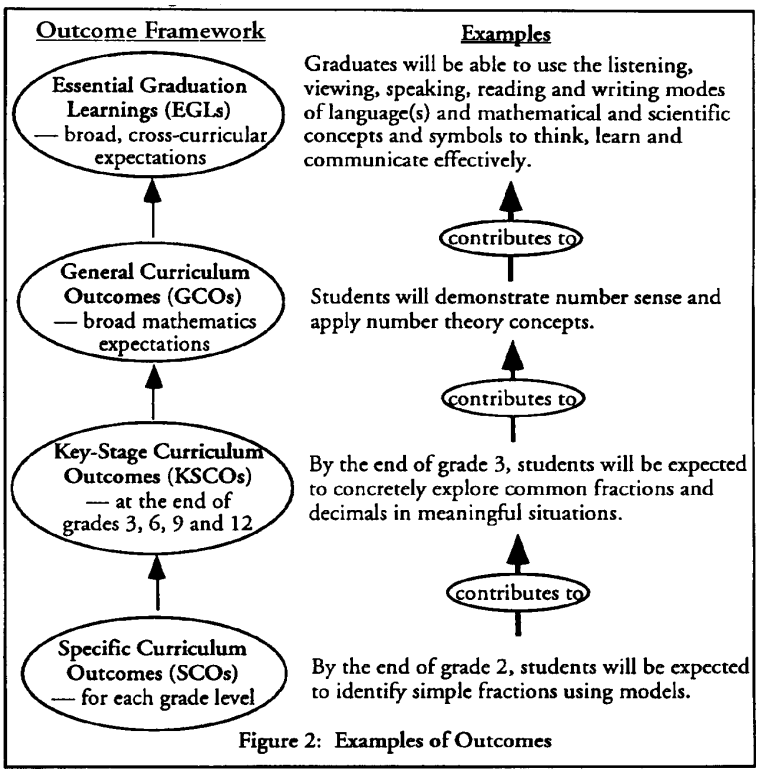


Figure 2: Examples of Outcomes

It is important to emphasize that, while the grade level outcomes (SCOs) provide a framework on which educators will base decisions regarding instruction and assessment, they are not intended to limit the scope of learning experiences. Although it is expected that most students will be able to attain the outcomes, some students' needs and performance will range across grade levels. Teachers will need to take this variation into consideration as they plan learning experiences and assess students' achievement.

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.

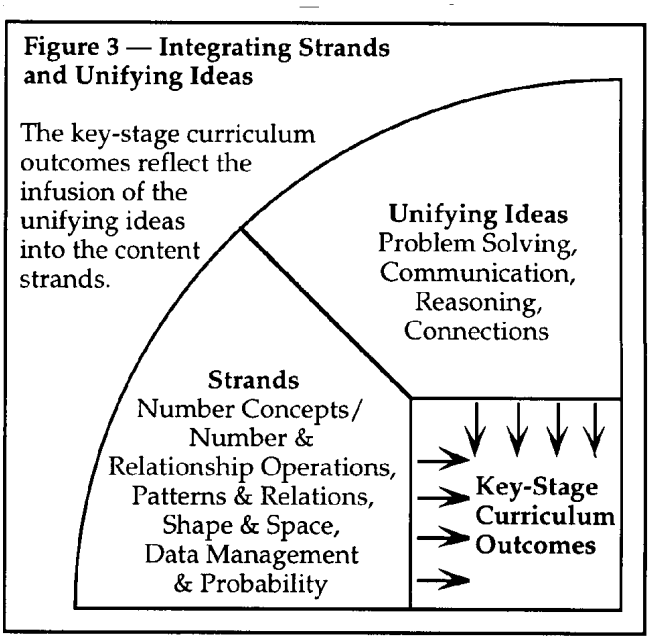
Decisions on sequencing will depend on a number of factors, including the nature and interests of the students themselves. For instance, what

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.

C. Learning and Teaching Mathematics

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.

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 development 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' 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 ❒ .

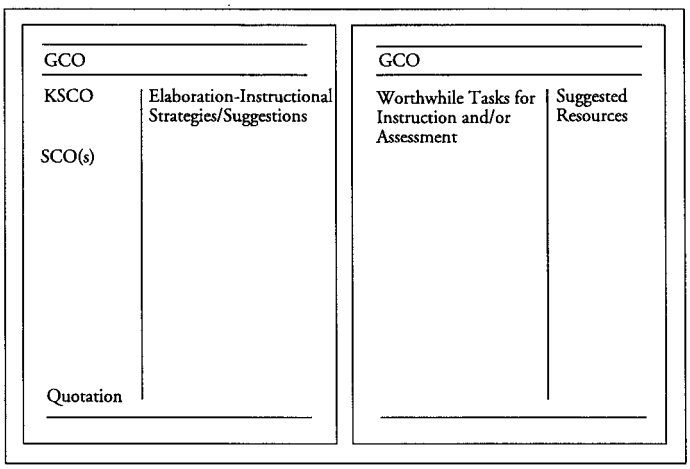


Figure 4: Layout of a 2-Page Spread

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 (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).

ONE-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 grade 1, students will be expected to

A1 compare two sets for size in a variety of ways

A2 create equivalent sets and sets which differ by small amounts

Children who have number sense understand how numbers relate to each other and furnish information about the world. Number sense evolves from a child's total experiences as well as through specific activities. When first-grade children count things in the classroom or explore the operations of addition and subtraction, they are extending their earlier ideas of number. When they organize and compare groups of objects and examine multiple representations of the same numbers, they continue to broaden their understandings. These new ideas about number relationships provide a foundation for understanding number magnitude, estimation, and the effects of arithmetic operations. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 6)

Elaboration - Instructional Strategies/Suggestions

A1 Students should compare the size of sets in many different contexts. Include situations in which

- the sizes of the sets are the same
- the sizes of the sets differ

This will lead to exploring number relationships such as "one more than," "one less than," "two more than," etc.

When students compare sets, ensure that sometimes the two sets are

- lined up side by side and the students pair the items
- grouped in clusters and the students need to move the items to match them one-to-one and compare the size of the sets

It is desirable, at times, that the items in the sets go together naturally (e.g., left gloves/right gloves), and that at other times the items are unrelated. It is a natural extension for students to graph these comparisons.

Students might be encouraged to compare amounts to benchmarks such as 0 or 1, 5 or 10, so as to get a feel for the relative size of quantities.

❒ Ask children to sort a collection of buttons by various criteria (e.g., number of holes, size, shape, texture, colour) and compare the size of the sets.

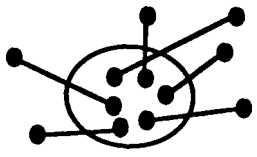
A2 Students should be able to create a set equal in number to a given set by matching one-to-one. Include situations in which students need to

- add items to one set
- take items away from one set

❒ Invite students to make up story problems to solve; for example:

If the tooth fairy gives me a quarter for each tooth, and I have 4 quarters so far, how many teeth have I lost?

❒ Invite students to create their own "dot" stories; for example: If the dots inside the circle are seats on a bus and the dots outside the circle are children, the story might be that there are just enough children to fill the seats.



Students should be able to create a set which is

- one more than a given set
- one less than a given set
- around 5
- a bit less than 10
- close to 0
- etc.

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

A1.1 Ask the student to compare the number of letters in his/her first name to the number in his/her last name to see which name has more.

A1.2 Divide a group into teams, unequal in number. Ask the student to "fix" the teams so that the group is fairly distributed.

A1.3 Put out a set of 10 photos, each of which includes a person or people. Ask the student to sort the photos into two groups and decide which group has more photos. Students might graph the two group sizes.

A1.4 Have the students play "Dot Bingo."

Rules:

- Take turns rolling a die.
- Cover any one square that is one more than the top number on the die.
- The player who first covers three in a row is the winner.

Ideas - Arithmetic Teacher

Game: Dot Bingo

2	4			7
	3	3		
7	5	Free		6
		4		
6		3		4

A2.1 Show the students several right-hand prints and a smaller number of left-hand ones. Ask them to dip their hands in finger paint and end up with as many left-hand prints as right-hand prints.

A2.2 Provide a geoboard. Ask the student to make two shapes, one with almost 5 sides and another with one more side than the first.

Interview

A1.5 Ask: How might you find out if more people like or dislike peanut butter?

A1.6 Place 3 red counters and 2 blue counters in one group and 3 blue and 2 red in another, as shown:

RRR BBB
BB RR

Ask: How do you know there are the same number of each colour?

A1.7 Ask: Where might you see more adults than children? Why?

A2.3 Line up 7 boys and 3 girls. Ask: What must be changed to make the number of girls equal to the number of boys?

Presentation

A1.8 Have students, working in groups of 4, write down their favourite names (not their own). Ask them which name has the most/least letters. Have them share their findings with another group.

Suggested Resources

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 grade 1, students will be expected to

A3 count in a variety of ways

A4 sort sets based on number

There is a difference between being able to count . . . and knowing what counting tells. When we count a set, the last number word used is the name of the "manyness" of the set or the "cardinality" of the set. (Elementary School Mathematics, p. 88)

Elaboration - Instructional Strategies/Suggestions

A3 Students should be encouraged to count items in natural situations that arise in the classroom. They should also continue to practise rote counting. Include situations which require

- counting forwards and backwards
- counting on by ones from a given number
- skip counting (e.g., 2, 4, 6, 8,... 1, 3, 5, 7,...)

❒ Ask students to count items which occur naturally in twos (e.g., shoes, hands, eyes).

❒ Place 5 counters under a cup and tell the students that they are there. Show 3 more beside the cup. Ask: How many counters are there altogether?

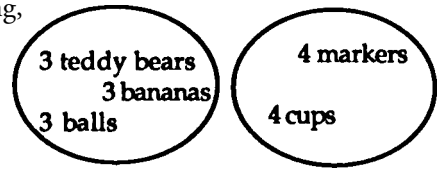
❒ Invite students to sing songs and recite poems which involve counting backwards and forwards; for example:

- "Ten In A Bed"
- "One, Two, Buckle My Shoe"
- "This Old Man"

❒ Use literature such as *The Wonderful Pigs Of Jillian Jiggs* by Phoebe Gilman. Ask a student to show various ways to count the pigs.

❒ Invite students to use calculators to count. For example, as some students place cookies into a bag and count aloud, others may repeatedly add one on calculators to keep track electronically.

A4 To demonstrate an understanding of the concept of number (e.g., "3"), students must be able to distinguish sets which have three items from those which do not. They should be presented with situations similar to the following,



and asked why they think the sets are grouped as they are.

As well, include situations in which sets have the same number of items but differ in the amount of physical space they cover.

❒ Have students look around the room to find as many sets as possible containing a given number of items; for example, find sets which contain exactly 2 items.

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

A3.1 Ask the student to count backwards starting at 8.

A3.2 Ask the student to count aloud to 50 by 5s while using the counting constant of the calculator.

(The keystrokes might be [5] [+] [5] [=] [=] [=] . . . .)

A3.3 Ask students to count a large number of items in a photo. Observe how they count.

A4.1 Ask students to find a number of pictures, making sure that each picture shows the same amount.

Paper and Pencil

A4.2 Have students work in pairs and make a list (words or drawings) of all the things they can think of that come in twos.

Interview

A3.4 Ask: If you count by twos, starting at 0, will you say 7? Why or why not?

A4.3 Show students a set of 3 small items, a second set of 4 small items and a third set of 3 large items. Ask: What set might not belong? Why?

Presentation

A4.4 Ask students to work in pairs to decide if there are more items in the room that come in 3s or 4s. Have them share their findings with other groups.

A4.5 Ask students to describe and act out parts of a story in which there are several groups with the same number of items in them (e.g., 3 bowls, 3 chairs, 3 beds in "Goldilocks and the Three Bears").

Suggested Resources

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 grade 1, students will be expected to

A5 match quantities with numerals

A6 count beyond 10 in a variety of ways

A7 estimate amounts between 10 and 100

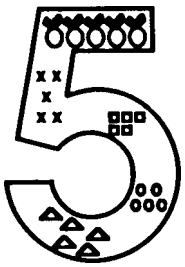
Elaboration - Instructional Strategies/Suggestions

A5 Using numerals is society's way of communicating about number size. It is important, therefore, that students become familiar with these standard symbols at this time. Students need to

- create or collect sets, given a numeral
- assign numerals to sets

Some students will need additional practice recording numerals. Tactile experiences such as tracing numerals and copying them are useful.

❒ Provide a large cutout or drawing of a numeral (e.g., 5). Invite children to create a collage of sets representing that numeral by gluing on pictures or drawings.



A6 Students should experience a wide variety of situations which require counting beyond 10. (Students will be expected, however, to deal only with 2-digit numbers at this grade level.) Include

- skip counting by 2s, 5s, 10s (starting from 0, as well as from other numbers)
- counting using coins (pennies, nickels, dimes)
- counting on from a given number
- counting back from a given number

(Note: This outcome is an extension of SCO A3.)

A chart showing the numbers from 1 to 100 in lines of 10 (a hundreds chart) is an excellent tool for these activities. For example, when skip counting by 5s, students might put a counter on every 5th number, reading the number as the counter is placed on it.

❒ Ask students to use the repeat function on the calculator to skip count to a target number. For example: If you start at 0 and want to end on 40, by which number(s) could you skip count? What if you started at a different point? What if you wanted to end at a different point?

A7 Students should be provided with collections of objects (e.g., marbles, bread tags, counters, pop bottle tops) and asked to estimate the size of the group. For small groups, ask: Is it closer to 5 or 10? For large collections, one might be asking whether the group is closer to 20 or 50. The ability to estimate should develop with regular practice over the course of the year, with larger collections being examined later in the year.

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

A5.1 Use attribute blocks. Ask a student to make sets of
- 8 different shapes
- 4 blue triangles
- 5 yellow shapes, etc.

A5.2 Provide several sets of varying quantities and a set of numeral cards. Ask the student to match the appropriate cards with the sets.

A5.3 Provide string and pasta. Ask the student to make a "6" bracelet, using 6 pasta pieces.

A6.1 Provide approximately 40 counters. Ask the student to find a way to determine how many there are without saying each number, 1, 2, 3, . . .

A7.1 Show a collection of about 30 counters and ask the students to estimate the number in the group.

Interview

A5.4 Ask the student to tell 3 things about the number 3.

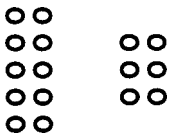
A6.2 Present 14 items to the student. Ask: How many would there be if there were 2 more? How did you find the answer?

A6.3 Show 32 scattered objects and then another 32 objects grouped into 3 groups of ten, plus two. Ask: How do the amounts compare? Which is easier to count? Why?

A6.4 Ask the student to begin counting at 13 and stop at 25.

A6.5 Provide a hundreds chart. Tell the student: I counted from 10 to 50 and only said 5 numbers. What do you think I said?

A6.6 Arrange counters as shown and observe students as they count them.



A6.7 Tell the student: I said, "10, 20, 25" when I was counting some coins. What coins do you think I had?

A7.2 Ask the student why it might be easier to estimate the size of a group of 13 counters than a group of 49 counters.

Suggested Resources

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 grade 1, students will be expected to

A8 demonstrate an understanding of simple fractional parts

Elaboration - Instructional Strategies/Suggestions

A8 Fractions are usually the first experience for children in which a number represents something other than a count. Children will generally need experiences with a wide assortment of materials in order to adequately develop fraction concepts. These materials include, among others, geoboards, counters, pattern blocks, egg cartons, grid paper, paper folding and circle pieces.

- One-half - Provide many and varied opportunities for students to explore the idea of one half in meaningful situations.

It is important that students understand the "sharing fairly" concept of one-half in which common objects are used (e.g, sharing a popsicle, a cookie, an apple). The emphasis should be on equal or same size parts. This "part of a whole" meaning can be extended to the "part of a set" meaning in certain situations; for example, when sharing a pizza that has been cut into 6 equal pieces, children can see that one half also means 3 of those 6 pieces.

The writing of symbols should be delayed until the fraction concept has been thoroughly explored. To record the amount in writing, it is preferable at this point for the teacher to write "3 fourths" rather than $\frac{3}{4}$.

❒ Invite pairs of students to make square construction paper pizzas and "cut" them into various numbers of equal pieces. Ask them to determine how many pieces each of them would get if they shared the pizza fairly and to present their findings to the class. (Note: Cutting pieces of various sizes would also allow exploration of the concept of fair shares.)

- Other simple fractional parts - Explore one-fourth, one-third, and other fractional parts such as fifths, sixths, eighths, or tenths where they arise in context (e.g., pizzas cut into slices, hexagons split into 6 equilateral triangles). The "pie", "pizza" and "chocolate bar" models work well. Continue to present the "fair share" concept, stressing a whole being divided into equal shares. Emphasize fraction families; for example, if a whole is divided into four equal shares, we might discuss 1, 2, 3 or 4 of those shares, and that all of those "fourths" belong to the same family. Similarly, the tenth family includes seven-tenths (seven of those shares) and three-tenths (three of those shares). From the other perspective, if students hear "five-tenths", they know that this is a member of the tenths family and the whole was split into ten equal fair shares.

Informal experiences will help students see that when wholes are divided into a greater number of fair shares, the shares are smaller. No formal comparison work, however, should be undertaken at this point.

Although children in subsequent grades will use "fourth" and "quarter" interchangeably, it would be inappropriate to use the term "quarter" at this stage.

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

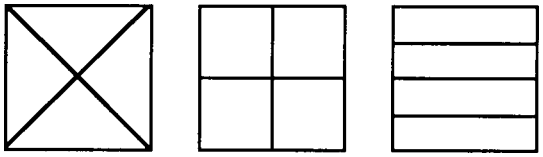
Worthwhile Tasks for Instruction and/or Assessment

Performance

A8.1 Ask students to show one-half of a group of objects.

A8.2 Ask students how to split a symmetric building (made of multilink cubes) to show halves.

A8.3 Give the students a square piece of paper and ask them to show one fourth by folding. Have the students compare their fourths. Are they the same shape? Are they all really fourths?



Interview

A8.4 Ask: Why does it not make sense to say "the bigger half?"

A8.5 Ask: When might you hear someone talk about one-half?

A8.6 Ask: What is meant when we say "2 equal parts?"

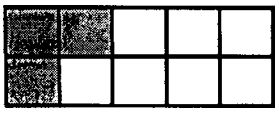
A8.7 Tell the student that sometimes we say, "She was third." Other times we say, "She gets one-third." What is the difference in the meanings of the word "third"?

A8.8 Ask the student to give an example to show when getting one-fourth of something means getting a lot, and another example to show when getting one-fourth means getting a very small amount.

A8.9 Ask a pair of students to describe a way to organize their classmates so that one-half are at the front of the room, the other half at the back. Encourage students to suggest different ways of doing it. How can they be sure that they have one-half?

Portfolio

A8.10 Ask the student to examine the picture and describe the family (tenth) shown, naming some members of that family.



Suggested Resources

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) and

iv) *order whole numbers and represent them in multiple ways*

SCO: By the end of grade 1, students will be expected to

A9 order numbers and use ordinal language

A10 explore the meaning of the numbers between 10 and 20

Children need to be encouraged to talk and write about what they have learned. . . . Researchers have found that most children learn best if they discuss their work. Other studies also indicate that paper-and-pencil activities should follow extensive exploration of numerical relationships with manipulatives. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 6)

Elaboration - Instructional Strategies/Suggestions

A9 Students should

- use ordinal numbers to identify position (e.g., Which is 3rd?)
- relate ordinal words and symbols (e.g., third with 3rd)

(Note: By the end of grade one, students should generally be using ordinal numbers through to 10th.)

Students should also recognize the relative aspect of ordinals. In the diagram below, for example, the triangle is second if we count from the left, but third if we count from the right.

- ❒ The students are standing in a line. Ask: Who is eighth?
- ❒ Ten children are standing in a line. Ask: If ____ is fifth in line, where did I start counting?
- ❒ Invite children to use coloured counters to create a pattern such as

- Ask them to predict what colour a particular one will be (e.g., the 10th).
- Ask them to make a pattern in which every (4th, 5th, etc.) counter will be yellow. (See also SCO C2.)

A10 Before students are introduced to place-value concepts, they need opportunities to explore the numbers between ten and twenty. The uniqueness of the "teen" numbers must not be overlooked. When dealing with numbers such as 28 or 46, we "hear" the tens number first; that is, we say the "twenty" and the "forty" first. This is not the case with eleven, twelve, or the "teen" numbers. Children at this level need to understand that eleven is 10 and 1 more, twelve is 10 and 2 more, and 16 is 10 and 6 more.

The development of this concept should not be rushed, and it is not appropriate to discuss place-value concepts at this time (e.g., expecting the students to tell what the "1" in "16" represents). The "ten set," however, figures prominently in all explorations when developing number meanings for 11 - 19. Provide the students with a number of counting activities in which sets of items numbering 11 through 19 are counted. Students will be developing number sense and recognizing that certain groupings, such as a group of ten and 7 more, make it easier to determine the size of the set (a pre-place value concept).

Students might explore the usefulness of the idea of grouping by tens - for example, 24 is 20 and 4 more - again without concentrating on the positioning of the digits.

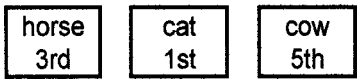
- ❒ Have students count out 10 counters on one side of a 2-part mat. Have them place 5 counters on the other side. Together count all the counters by ones. Say "Ten and five is fifteen." Turn the mat around - "Five and ten is fifteen." Repeat with other numbers without changing the 10 side of the mat. (See Elementary School Mathematics, p. 102.)

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

A9.1 Ask a child to place a set of farm animals in a line by following directions given on cards; for example:

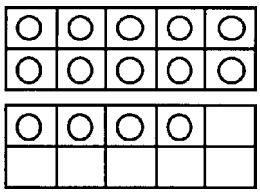


A9.2 Ask students to use counters to create a pattern in which the amount in the 4th position is less than the amount in the 3rd.

A9.3 Ask the student to make a linking cube train in which the 3rd and 5th cars of the train are different colours from the rest of the train.

A9.4 Ask the student to draw a row of shapes in which the first shape is round and the third is square. How many shapes might there be?

A10.1 Provide 2 ten-frames and counters for each student.



Ask the students to model fourteen with the counters. (Note: for numbers greater than 10, one ten-frame must be completely filled; for 5 and under, use the top row only.) Have them say aloud, "ten and four are fourteen." Practise with other numbers.

Observe the students as they model additional numbers.

- Do they remove all the counters?
- Do they remove all the counters on the bottom frame?
- Do they add to/remove counters on the bottom frame?
- Are they able to verbalize appropriately?

Interview

A9.5 Ask: What is the third thing you do when you arrive at school?

A9.6 Ask: If there are 8 people standing in line, and you are counting this way, 1st, 2nd, 3rd,..., what will you say last?

A9.7 Show a sequence of pattern blocks. Describe one of the blocks and ask the student to identify its position.

Suggested Resources

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) and

iv) order whole numbers and represent them in multiple ways

SCO: By the end of grade 1, students will be expected to

A11 model numbers grouped in tens and ones

Children need to be encouraged to talk and write about what they have learned. . . . Researchers have found that most children learn best if they discuss their work. Other studies also indicate that paper-and-pencil activities should follow extensive exploration of numerical relationships with manipulatives. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 6)

Elaboration - Instructional Strategies/Suggestions

A11 Students should be encouraged to think about items that come in natural groups; for example, 5 fingers at a time when looking at hands, 4 children at a time when looking at tables of children in some classrooms. They should notice that we might say 20 fingers, but might say 4 hands, using the grouped number. Similarly, we might see 20 children, but we might think of it as 5 tables of children. This grouping idea naturally leads into grouping by 10, the value upon which our place-value system is based.

After exploring a variety of grouping sizes, students should begin to concentrate on grouping by tens. Proportional, groupable models should be used first, that is, materials which can be put together or taken apart to make (or unmake) tens which are ten times the size of the ones. Suggested materials are Popsicle sticks which can be placed together by rubber bands in groups of 10, linking cubes which can be connected to make strips of 10, or 10 beans which can be bagged or placed in cups.

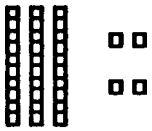
It is important that this stage not be rushed. Many problems that children later encounter with place-value concepts are believed to stem from inadequate attention to early place-value activities. The major objective here is helping the children make that important connection between all that they know about counting by ones and the concept of grouping by tens.

- ❒ Give each student a different number (e.g., 25, 36, 42, 48 . . .) of counters. Ask: How many do you have? Ask students to combine their counters in groups to make it easier for a classmate to count them; for example, 25 might be grouped as 5 groups of 5 or 36 as 7 groups of 5 and 1 more or 3 groups of 10 and 6 more. Have half the class go from desk to desk counting the number of counters each classmate has. The other half of the class then takes its turn. Encourage a variety of oral counting (e.g., for 36: 1, 2, 3, . . ., 34, 35, 36 OR 5, 10, 15, 20, 25, 30, 35, 36 OR 10, 20, 30, 31, 32, 33, 34, 35, 36, depending on the size of the group).

Students should proceed from the "groupable" model to a "pre-grouped" proportional model. The size of the ten model continues to be equivalent to 10 of the ones models; the difference is that the ten cannot be separated into individual ones. Examples are 10 beans glued to a stick, Cuisenaire rods, or base-ten rods.

- ❒ Ask students to
  - model numbers using pre-grouped materials
  - record numbers from an existing model
  - show how to count an amount that is modelled

Example:



34

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

A11.1 Give the student 45 coffee stir sticks. Ask him/her to bundle them in groups of ten. Ask: How many sticks are there? Note how the student responds. Is he/she counting by groups of ten? considering this easier than counting by ones? demonstrating that there are really 45 sticks altogether?

A11.2 Ask the students to record the letters of the alphabet, or the names of some of their classmates, in ten-frames without leaving any spaces; for example:

S	A	N	D	Y
M	A	R	K	O

L	I	V	I	A
A	L	Y	S	O

N	S	T	E	V
E	N	L	A	N

C	E	A	M	Y
L	I	S	A	A

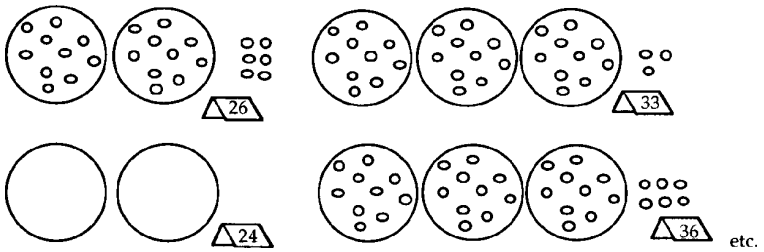
N	N	J	E	F
F				

Ask: How many letters are there in all?

A11.3 Have students play a game in which the roll of a die tells how many pennies they can accumulate. Once they have 5 pennies, they must exchange them for a nickel. The first player with 5 nickels wins the game. As the students play, ask questions; for example, I see 2 nickels and 3 pennies. How many pennies is that worth?

A11.4 Show a number of base-ten unit cubes (34, for example). Beside these show 5 rods and 6 unit cubes. Ask: Which has more? Is one easier to count than the other? Explain.

A11.5 Math Centre: Set out a number of arrangements of beans grouped by tens and individual units. Also have some empty stations. Provide the students with a set of prepared number cards. Direct them to place the matching card in front of the appropriate display and to build the arrangements for the other cards. Use, for example, 13, 16, 18, 24, 26, 28, 33, 36, 38, and 40.



You may wish to do a grouping activity such as this in which students are asked to determine the number of raisins in a small package or the number of M & M's in a bag.

Extensions would include using groupable and pregrouped proportional models and asking students to identify the number by matching the cards and displays. Take the opportunity to discuss with the students not only how they "counted," but the advantage of grouping in this manner.

Suggested Resources

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) and

iv) order whole numbers and represent them in multiple ways

SCO: By the end of grade 1, students will be expected to

A12 compare 2-digit numbers

Elaboration - Instructional Strategies/Suggestions

A12 Students encounter many numbers in context. These contexts help them develop an understanding of number size. For example, a student might be asked: Which number probably tells how old your classmate's dad might be – 5, 35, 85? How do you know?

When comparing two numbers, students might make use of benchmarks as reference points. For example, 48 < 95 since 95 is closer to 100; 37 > 27 since 37 is more than 30 and 27 is less than 30. This reasoning process will help develop number sense.

Frequently, students will refer to the number of tens in a number in order to compare it to another. For example, 47 > 21 since 47 is more than 4 tens, but 21 is only a bit more than 2 tens. This type of language is preferable to language such as "4 is more than 2 so 47 is greater," particularly since children should focus on the fact that the 4 in 47 is 40 and not 4 and the 2 in 21 is 20 and not 2.

The hundreds chart is a particularly valuable reference device for number comparison since students easily learn that down and right means greater. However, it is also important for students to see concrete models of numbers (e.g., using base-ten blocks) to get a visual sense of the difference in size of the numbers being compared.

Students should recognize

- that every 2-digit number is greater than every 1-digit number
- that to compare 2-digit numbers, the tens digit is the most vital element of the number
- situations in which the units digit is important in comparing numbers (e.g., 32 vs 34)

❒ Provide cards with 2-digit numbers, such as

Pairs of students each select a card and model the number with centimetre cubes. After counting to verify, they join cubes together and cut pieces of string of equal length. Numbers can then be compared for size by comparing the length of the pieces of string.

Note: A variety of concrete materials can and should be used to model numbers, and to "group" into tens and ones. For example, beans and other small objects might be collected and grouped 10 to a yogurt cup, a jar lid, etc.

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

A12.1 Ask a student to use a model to show why 42 is greater than 29.

A12.2 Provide 9 base-ten rods and 9 unit cubes. Have the student create two different amounts, each using exactly 5 of the objects provided. Ask: Which amount is greater than the other? How is it possible to use the same number of objects, but still have one greater than the other?

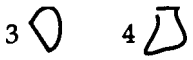
Paper and Pencil

A12.3 Provide a teacher-made "flyer" in which prices are less than a dollar. Ask the student to circle the item that costs the most (the least, more than 50 cents, etc.).

Interview

A12.4 Ask the student to use a hundreds chart to explain the relative positions of the numbers 36 and 52.

A12.5 Show students a paper on which the units digits of two numbers are smudged; for example,



Ask: Can you tell which number is greater? Why?

A12.6 Ask: Is a number with a 7 in it always greater than a number containing only digits less than 7? Explain.

Presentation

A12.7 Have pairs of students discuss when they might want to compare the sizes of two numbers and present their ideas to the class.

A12.8 Have students work in small groups to list some situations in which they would rather have 22 than 28 (e.g., golf score, race time, brussel sprouts).

Suggested Resources

ONE-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

i) demonstrate an understanding of the connection between relevant, concrete experiences and the mathematical language and symbolism of the four basic operations

SCO: By the end of grade 1, students will be expected to

B1 recognize that addition is used to represent the joining of two groups

. . . "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 As with many early concepts, the development of the meaning of addition cannot be rushed. It is important that students have extensive investigative experiences in which they use concrete materials to model addition. They also need experience interpreting how addition situations are portrayed in print. (Note: It may be helpful to present addition and subtraction situations together to show the relationship between the two concepts.)

Include examples of

- active situations which involve the physical joining of sets (e.g., I had 4 pencils and I bought 3 more. How many do I now have?)
- static situations involving the implied joining of sets (e.g., There are 3 boys and 4 girls. How many are there altogether?)

It is important that all of the following types of situations be presented:
- result unknown: I had 4 marbles and I won 3 more. How many do I now have?
- change unknown: I had 4 marbles and now I have 7. How many did I win?
- initial unknown: I had some marbles. I won 3 and now I have 7. How many did I have in the beginning?

Instructional decisions should include

- personalizing word problems for children
- using concrete materials
- manipulating materials on an overhead or chalk/flannel board as you relate a word problem. Verbalize as you manipulate; for example, "6 buttons and 3 more buttons are 9 buttons," and later, "6 buttons plus 3 buttons are 9 buttons."
- having students model word problems on the overhead for the class
- providing situations of stating both the lesser number first and greater number first
- modelling the advantage of counting on from the larger of two addends
- providing a mix of active and static questions

(Note: The focus, at this point, is on the meaning of the addition operation.)

Observe if the children

- count all objects to find the sum
- count on from one group to find the sum
- use the term "add" and/or "plus"
- can verbalize the problems as they set up the materials

❒ Pose story problems such as "Janet has 2 baseball cards. Mario has 4 hockey cards, and Paul has 2 football cards. How many sports cards do they have altogether?" Provide the cards and observe if students put them all in one pile and count or if they are using other strategies. Often, students will pick up on doubles facts early. Some may say "2 plus 2 is 4 and 4 more is 8." Students should be encouraged to use such strategies and share them with their classmates.

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 Choose a book, or make up a story, which tells about an addition situation and ask the student to model the situation with counters as you read the book.

B1.2 Model this problem, using manipulatives, for a pair of students: I had 5 pennies and now I have 9. How many pennies did I earn?
Ask the pair to make up a similar problem, using objects of their choice, and to model and describe it.

B1.3 Place a large number line on the floor, positioning a child on the 8 and facing the higher numbers. Ask: Where would you be if you jumped 4 spaces forward?

B1.4 Give the student a card (such as the one shown), a pair of dice, and some bingo chips. Ask him/her to roll the dice, find the total, and try to fill the card.

	11	7
6	4	8
10	2	3
9	5	12

Paper and Pencil

B1.5 Ask the student to make a drawing to show how many pencils Celia has if she has 2 blue ones, 6 yellow ones, and 3 red ones.

Interview

B1.6 Ask the student to think of a situation in a restaurant when someone might add.

B1.7 Tell the student that Carlos had 2 pennies and he earned 10 more pennies. Ask: How many does Carlos now have? Explain how you found your answer.

Presentation

B1.8 Present a number of shapes worth various amounts; for example,

Have the children create various designs, using the shapes, in each case describing how much the design would be worth.

Portfolio/Presentation

B1.9 Ask the students to interview someone at home to find situations in which that person uses addition. Have them make a list of some of these situations and share them with their class.

Suggested Resources

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

i) demonstrate an understanding of the connection between relevant, concrete experiences and the mathematical language and symbolism of the four basic operations

SCO: By the end of grade 1, students will be expected to

B2 recognize that subtraction is used to represent separating situations

Elaboration - Instructional Strategies/Suggestions

B2 One of the easiest meanings of subtraction for students to access is the concept of separation, or taking away. The student generally is told how many there are at the start, how many are taken away and is then asked to find how many are left. For example: There are 5 people at the table; 2 finish and leave. How many are left at the table?

Later, they can consider situations for which they know the number at the start, how many are left, and are asked how many are taken away. For example: There were 5 people at the table. Two are still there. How many left? Many students will think of solving this using a "missing-addend" approach (I need to add 3 to 2 to get to 5) even though the situation is a separating situation.

Include a variety of the following types of problems involving separation of sets:

Marie had 8 toys. She gave 3 to her friend. How many does she have left?
8 less 3 makes how many?

Marie had 8 toys, but gave some to her friends. She now has 5 toys. How many did she give away?
8 subtract a number leaves 5. What is the number?

Marie had some toys. She gave 5 away to her friends. She only has 3 left. How many toys did she have in the beginning?
A number less 5 is 3. What is the number?

When verbalizing separating situations, teachers might use
- 4 take away 3
- 4 minus 3
- or 4 subtract 3

It is advisable, however, to include as much descriptive language as possible. For example, if the problem were that there had been 6 cookies, and 3 had been eaten, the teacher might say, "6 cookies and 3 are eaten. How many are left?" rather than "6 take away 3" or "6 subtract 3."

It is desirable to combine adding and separating situations in a context. For example: You have 3 pencils. Your mom gives you 2 more. Then your brother borrows 1. How many do you have left?

As with addition, it is important that subtraction situations be personalized and students use materials to model problems.

Students might observe that
- it is sometimes easier to count back in situations in which only a few are removed (e.g., 8 - 2; count 7, 6)
- it is sometimes easier to count up from the number removed in situations in which most of the total is removed (e.g., 8 - 6; count 7, 8)

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

B2.1 Provide the children with a given number of counters. Ask them to remove 3 counters and tell how many are left.

B2.2 Ask the student to tell a "take-away" story involving 8 and 5.

Paper and Pencil

B2.3 Ask the student to make a drawing to model this problem: Robert had 10 baseball cards. His brother convinced him to give him 2 of the cards. How many cards did Robert have left?

Interview

B2.4 Tell the student that Jane had 9 pencils and lost 3, while Martha had 7 pencils and lost 2. Ask: Who has more pencils left? Explain how you know.

B2.5 Tell the students that you have a nickel and 4 pennies. You want to buy a candy that costs 3¢. Ask: How much money will be left? Tell how you know.

B2.6 Ask the student to discuss why it might be difficult to model a take-away situation when it is illustrated in a book.

B2.7 Tell the student that you had 9 marbles, but lost some. There are only 4 marbles left. Ask: How many did I lose? Show how you know.

Presentation

B2.8 Role play a "take-away" story for the class.

Suggested Resources

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

ii) recognize and explain the relationships among the four basic operations

SCO: By the end of grade 1, students will be expected to

B3 recognize the relationship between addition and subtraction

B4 recognize that subtraction can be used to solve missing addend problems

Addition and subtraction concepts are very closely related. Both can be derived from the same basic relationships between sets: either a part-part-whole relationship or a comparison relationship. (Elementary School Mathematics, p. 110)

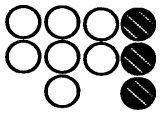
Elaboration - Instructional Strategies/Suggestions

B3 Children should be aware that every time they encounter either an addition or a subtraction situation, the other operation is implicit. In fact, some children may see the same situation in these different ways.

For example: There are 9 children. Three are boys. How many are girls? Some students see this as an addition. (Three + how many are 9?) Others see it as a subtraction. (There are 9 in all. Remove the boys. How many girls would be left?)

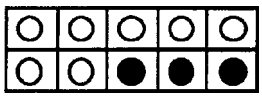
- A nice activity might be to have the students spill 10 two-coloured counters. Ask them to describe the addition and subtraction situations that are shown.

  For example:



  7 and 3 are 10; 3 and 7 are ten; if 3 is removed from 10, 7 are left; if 7 are removed from 10, 3 are left.

A ten frame is a visual that makes the "7" and "3" combination for 10 very clear.



Students might also think about the idea that subtraction and addition "undo" each other. That is, if 3 are subtracted and then added, or vice versa, it is as if nothing happened.

B4 Missing-addend situations are those in which a total and one part are known and the other part is sought. (For example: There are 8 pink and purple flowers. Four are pink. How many are purple? OR I want to buy a toy that costs $10. I have $3. How much more money do I need?)

Students can solve these problems directly by adding or they might think of them in terms of subtraction. For example, to solve the problem about the toy given above, students might begin with 3 counters and see how many must be added to get to 10, or else they might start with 10 counters, take away the 3 they have and see how many are left (representing the amount still needed).

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 Ask students to use counters or felt board pieces to make up an addition/subtraction story involving the numbers 7 and 3.

B3.2 Present 5 red counters and 3 blue ones. Have the student tell an addition story and a subtraction one while manipulating the counters.

B4.1 Have a student model the following situation and find the answer: For homework, I have to read a total of 7 pages. I have already read 3 pages. How many more pages must I read?

Paper and Pencil

B3.3 Tell the students that four more children want to play basketball than soccer. Ask them to create an addition story with this information.

Interview

B3.4 Develop a chart showing item prices, all under 10 cents. Ask: What could you buy with 10 pennies? What does 10 - 4 represent if one item costs 4 cents? Tell why.

B3.5 Ask: How does knowing that 5 + 3 = 8 help explain how much 8 take away 5 is?

B3.6 Ask: If you have 10¢, how much change would you get from a 7¢ purchase? Explain how you found the answer.

B3.7 Tell the student: I have $5 and I need $13. Ask: How much more do I need? Why do I get the same answer for the following problem: I had $13. I spent $5. How much do I have left?

B4.2 Tell the student that there are 7 days in a week. Two days are on weekends. Ask: How do you know how many days are weekdays?

Portfolio

B3.8 Have students use the numbers 3, 6, and 9 to tell a variety of "joining" stories and "taking-away" stories.

Suggested Resources

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

ii) recognize and explain the relationships among the four basic operations

SCO: By the end of grade 1, students will be expected to

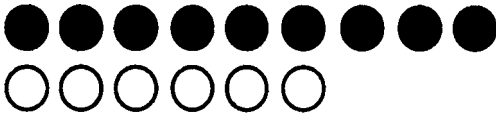
B5 recognize how to use addition or subtraction to solve comparison problems

Elaboration - Instructional Strategies/Suggestions

B5 Children are inclined to ask "who has more?" even when they are very young. Finding how many more by using subtractive thinking is something which often develops later.

There are many comparison situations which arise in everyday life. How many more people chose this centre than that one? How many more dolls do I have than you have?

To find how many more, children should model problems. For example, to find how many more dark counters there are than light ones, the students might model



and

- take away the number of white counters from the dark ones and count how many are left or
- count up from the 6 white counters to see how many extras are in the top row

These two strategies relate directly to the concepts of subtraction as take away and subtraction as missing addend. This need not be specifically discussed, but should be dealt with when and if students see the connections to other meanings of subtraction.

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

B5.1 Prepare a mixed group of items. Ask the student to sort the items into 2 groups, using any rule he/she chooses. Ask: What was your rule for sorting? Which of the 2 groups has more items? How many more?

B5.2 Ask the student to tell a "comparing" story, using the expression 8 - 5.

Paper and Pencil

B5.3 Tell the student that one number is 3 more than another. Ask what the numbers could be.

B5.4 Ask the student to make a drawing to model the following problem: Jake collected 8 bottle tops and Samuel collected 5. How many more did Jake collect than Samuel?

Interview

B5.5 Show a group of 4 boys and 2 girls, and another group of 3 boys and 3 girls. Ask the student to compare the number of children in each group and tell why the total number is the same.

B5.6 Ask: Why is taking 3 away from 5 like finding out how much more 5 is than 3?

B5.7 Display a bar graph showing house colours. Ask the student, for example, how many more live in white houses than in grey houses.

Presentation

B5.8 Have the students make up a skit in which one student has more of something than another and he/she brags about how much more.

Suggested Resources

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 grade 1, students will be expected to

B6 move freely among representing an addition or subtraction situation with a picture, a model, or a number sentence

For all four of the operations, models (usually sets of counters and number lines) and word stories or word problems are the two basic tools the teacher has to help students develop operation concepts. (Elementary School Mathematics, p. 109)

Elaboration - Instructional Strategies/Suggestions

B6 As students are introduced to addition and subtraction situations (see B1-B5), they will gradually begin to use number sentences to describe those situations. Models should continue to be used as long as students find them helpful. The connection between models, diagrams, and symbols should be explicitly discussed; for example, we write a + when things are joined; we write a + or - when things are separated or compared, depending on how the situation is viewed. (See discussion in B4 and B5.) Students should be able to start with symbols and show a model or picture or vice versa. It is essential that students understand how each part of the number sentence relates to the situation. For example:

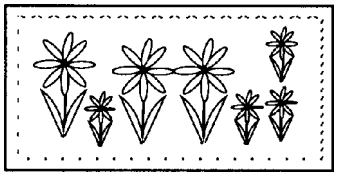
> There are 9 crayons. Only one is broken. How many are not? To solve this problem the student might write 9 - 1 = 8, or perhaps 9 = 1 + 8. In either case, it might be advisable to suggest that the 8 be circled since it is the quantity that is being sought.

You might invite small groups of students to act out situations. Others watch and choose a correct fact card (the one that matches the situation). Keep in mind that there may be several interpretations to a situation. For example, consider one in which 2 children are comparing the number of stickers they have (one has 7 and the other, 4). They want to know how many more one has than the other. Some students might think of a subtraction sentence (7 - 4 = 3), whereas others might think of an addition sentence (4 + 3 = 7).

Materials that may be used for modelling are virtually endless and include cubes, counters, beans, etc. At this stage, students not only model and symbolize a word problem, but should have practice providing a number story when a model and/or the equations are provided.

❒ Give the students a picture card and ask them to tell, or write, a story about the picture and write a number sentence.

Example:



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

B6.1 Provide each student with one of the cards shown.

Ask the student to tell a number story for which that card might be used.

B6.2 Provide students with play people or toy vehicles. Ask them to act out stories involving addition or subtraction, recording the number sentences that go with the stories.

Interview

B6.3 Ask students to create a number story for each of the following:
5 - 2
8 + 4
5 + 3 - 2

B6.4 Have students describe situations in which a person has to subtract (or add).

B6.5 Ask: Is it possible for a number such as 3 to be a sum and a difference? Explain.

Presentation

B6.6 Students might create story books involving both addition and subtraction. The teacher could facilitate the creation of a big book for the class.

Suggested Resources

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

iv) demonstrate proficiency with addition and subtraction facts and

v) apply computational facts and strategies with respect to the four basic operations and model addition and subtraction in situations involving whole numbers

SCO: By the end of grade 1, students will be expected to

B7 use mental strategies to find sums to 18 and differences from 18 or less

B8 memorize simple addition and/or subtraction facts from among those for which the total is 10 or less

For those children who do not spontaneously develop efficient fact strategies, it is our job to help them do so by engaging them in activities that will encourage construction of these helpful relationships. (Elementary School Mathematics, p. 134)

Elaboration - Instructional Strategies/Suggestions

B7 When students' thinking has developed at least to the point where they are counting on from the large number, strategy learning should begin. Children should be encouraged to use the relationships between facts to learn new facts, rather than using counting to find sums or differences. For example, if students want to add 3 + 3 and know that 2 + 3 = 5, they might think that 3 + 3 is 1 more than 2 + 3, so it must be 6.

Other useful strategies include

- relating to a doubles fact (e.g., 3 + 4 = 3 + 3 + 1 more, so 6 + 1 = 7)
- relating to 5 or 10 (e.g., for 8 + 9, add 2 to 8 to get to 10; that leaves 7 from the 9 so the answer is 17)
- counting on (e.g., 8 + 3 -- 9, 10, 11)

The use of strategies provides a foundation for mental mathematics.

An addition table might be useful to help students visualize relationships. For example, all the sums for 4 can be found by taking a known fact (e.g., 4 + 0 = 4) and reducing one number while the other is increased (e.g., 3 + 1 = 4). Notice that all of these are along a diagonal of the table.

+	0	1	2	3	4	5...
0	0	1	2	3	4	5...
1	1	2	3	4	5	6...
2	2	3	4	5	6	7...
3	3	4	5	6	7	8...
4	4	5	6	7	8	9...

B8 Some students will be able to respond instantly when an addition or subtraction fact is presented. Others will need an extra few seconds in order to use a strategy to find the answer. Eventually, it is helpful to the child to have instant recall, but it is not essential that all facts be recalled in grade 1. By using facts frequently in games and problems, most students will commit them to memory.

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

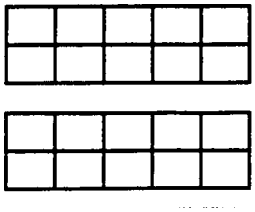
Performance

B7.1 Ask students to choose any number, add 10 and then take away 1. Have them repeat with other starting numbers, observing what happens and describing any pattern that they see.

B8.1 Have students play bingo; the teacher calls out a number (e.g., 5) and the students cover two items on the card (e.g., 3 + 2 or 6 - 1 or 10 - 5).

Paper and Pencil

B7.2 Ask the students to use the ten frames below to help figure out 8 + 5.



B7/8.1 Ask the students to list 3 other facts that would be easier to remember if they know that 6 + 5 = 11.

Interview

B7/8.2 Using counters, show 4 + 2 = 6 and 5 + 2 = 7. Ask the student to describe how the two facts are the same and how they are different.

B7/8.3 Two addends that combine to make ten are sometimes called "magic numbers" or "special 10 numbers" (e.g., 8 + 2, 4 + 6). These serve as good reference points for children. Develop a game situation in which students identify pairs of magic numbers. (Note: These provide a basis upon which strategies may be applied. For example, a child might think, "I know 7 + 3 is 10, so 7 + 4 is one more, or 11.")

B7.3 Ask the student how he/she could use 6 - 4 = 2 to figure out 6 - 3.

B7.4 Tell the students: I am using a dime to pay for 4¢ worth of candy. To find the change I say, “1 makes 5 and 5 makes 10. The change is 6¢.” Have the students explain the process.

Presentation

B8.2 Students might be encouraged to create and present a game that involves knowing and/or using addition and/or subtraction facts. The game could be presented either to other students or, perhaps, to parents.

Suggested Resources

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 grade 1, students will be expected to

C1 create and recognize physical configurations for numbers

C2 reproduce, extend, and create simple patterns based on number

Patterns weave mathematical topics together. Through the study of patterns, children learn to see relationships and make connections, generalizations, and predictions about the world around them. Working with patterns nurtures the kind of mathematical thinking that empowers children to solve problems confidently and relate new situations to previous experiences. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 1)

Elaboration - Instructional Strategies/Suggestions

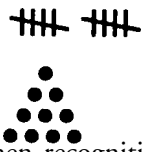
Patterns is a topic which emerges in all curricular areas and not just mathematics. There are, however, patterns particular to mathematics that should be explored.

C1 Children need to be able to recognize, without counting, various configurations, or spatial patterns for small numbers of items. This will be useful with respect to

- addition; for example, 5 = 4 + 1 (or 2 + 1 + 2) is apparent from

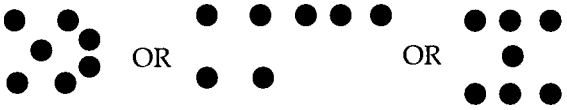
and 6 = 3 + 3 or 2 + 2 + 2 is apparent from

- place value; for example, groups of 10 can be easily observed in



(Note: Dice games strengthen recognition of several physical configurations.)

Provide opportunities for students to discover which configurations are easiest to recognize. For example, ask students to show 7 in several ways, and then decide which configuration(s) is (are) easiest to identify. Possible configurations might include



C2 Number patterns that students reproduce and extend may be based on numerals or actual objects which must be counted in order to interpret the pattern.

- A numeral pattern might be

  3 1 3 1 ...

- A shape pattern based on number might be

Students might reproduce patterns, using other objects or sounds. They might also create patterns for other students to extend.

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

Worthwhile Tasks for Instruction and/or Assessment

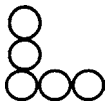
Performance

C1.1 Ask the student to arrange 8 counters in a way that will make it easy to tell that there are 8.

C1.2 Ask the student to make (a) sketch/sketches showing how he/she "sees" 9.

C2.1 Students can create audio tapes of clapping patterns, or use stickers or coloured counters, to make their favourite visual patterns.

C2.2 Show students 5 counters arranged in an L-shape with equal sides. Ask: What other numbers of counters can be arranged to form "Ls"?

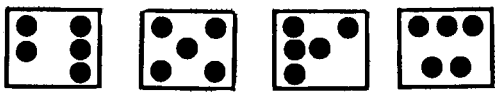


C2.3 Provide a hundreds chart. Ask the student to colour all the numbers he/she says when counting by threes, and to describe the pattern(s) he/she observes.

Interview

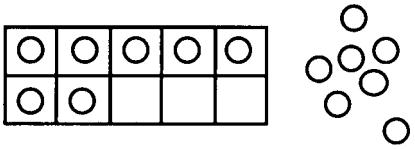
C1.3 Arrange counters on an overhead projector. Switch the light on for a few moments, but not long enough for students to count the counters. Ask: What number was represented? (Repeat several times, using different configurations of the same number.) Ask: Which configuration was easiest to recognize? Why?

C1.4 Briefly show a series of dot cards; for example,



Ask the student what he/she notices.

C1.5 Explain why it might be easier to count the number of counters on the left than the number on the right.



C2.4 Tell the student this is the start of a pattern:

Ask him/her to tell 3 things that might follow.

Suggested Resources

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 grade 1, students will be expected to

C3 sequence events

C4 create patterns with 3-D solids and 2-D shapes

First-grade patterning activities are often extensions of those used earlier. The focus in kindergarten is on repetition of events or designs using sound, motion, shape, and quantity. In the first grade there is continued emphasis on extending patterns and transferring them from one medium to another. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 1)

Elaboration - Instructional Strategies/Suggestions

C3 Sequencing events is based on the temporal patterns of a child's experiences. Students should have opportunities to sequence events, using language such as

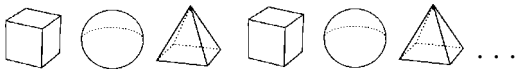
- before/after
- first, then, last

It may be appropriate to consider the order of events in a day, days of the week, and months of the year, as well as sequences for performing various tasks.

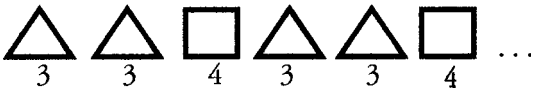
C4 Students might observe many spatial patterns in their environment. In creating patterns with shapes, students need to focus on the attributes of the shapes they have chosen.

Students could create patterns for which the pattern rule depends on

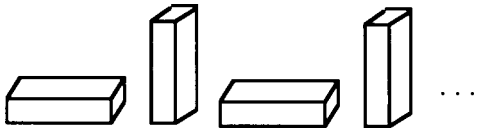
- the name of the shape - for example:



- the number of sides - for example:



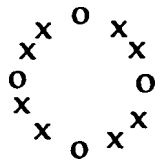
- orientation - for example:



- the type of side (straight or curved) - for example:

Encourage students to create patterns which are not necessarily in a straight line; for example:

- circular patterns



- multi-directional patterns

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 a calendar. Present the problem: Your mom, your sister and you take turns tidying up the living room floor at the end of the day. If your next turn is on Friday, on which days will your following two turns be?

C4.1 Request that the student use pattern blocks or attribute blocks to construct a simple pattern. Ask her/him to explain the pattern to another student.

C4.2 Ask the student to continue the pattern begun below in two different ways.

C4.3 Ask the student to make a pattern so that a triangle is the third item.

Paper and Pencil

C3.2 Draw simple pictures, using one item per picture, to represent, in order, the first five things you do when you arrive at school.

Interview

C3.3 Tell the student that you think there is a pattern to the days (Monday, Tuesday...) in a week. Ask the student to explain the pattern.

C3.4 Ask the student to explain, in order, the steps that you follow to find 8 + 5 using counters.

Presentation

C3.5 Have the students ask someone at home for (an) example(s) showing that it is important to do things in order when baking/cooking. Be prepared to share your information with the class.

Suggested Resources

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

ii) use patterns to solve problems

SCO: By the end of grade 1, students will be expected to

C5 use number patterns to help solve addition and subtraction sentences

Elaboration - Instructional Strategies/Suggestions

C5 Students should work with the pattern formed by the 3 numbers in a traditional fact family; for example,

$3 + 5 = 8$
$5 + 3 = 8$
$8 - 3 = 5$
$8 - 5 = 3$

They should be encouraged to use this pattern when faced with a subtraction such as 9 - 6 to which they may not have an immediate answer. They can be helped to recognize 9 - 6 is part of the family that includes 6 + 3 = 9 and, therefore, 9 - 6 = 3.

Students should also be provided with experiences with other fact patterns. For example, the pattern

$4 + 5 = 9$
$5 + 5 = 10$
$6 + 5 = 11$

might help a student determine that 7 + 5 = 12.

Using concrete materials (such as counters) to model fact families and addition and subtraction situations will be very advantageous to most students at this stage.

The hundreds chart and addition table also provide good models to develop patterns. For example, consider the illustration shown at the right. Coloring every fifth number in the chart, students will practise skip counting by 5s. They should be helped to see that going down one row is like adding 10.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

+	0	1	2	3	4	5	...
0	0	1	2	3	4	5	...
1	1	2	3	4	5	6	...
2	2	3	4	5	6	7	...
3	3	4	5	6	7	8	...
4	4	5	6	7	8	9	...
⋮							

Using the addition table, students might observe that the number in any line is one more than in the preceding line since one addend is increased by one and the other is not changed.

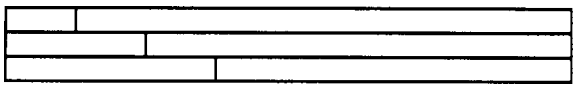
Seeing many different representations of the same pattern helps children learn to generalize and recognize patterns in broader contexts. Noting similarities and differences in several examples of the same pattern develops skills in using pattern recognition to solve problems. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 1)

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

C5.1 Ask the student to use Cuisenaire rods (or another suitable manipulative material such as multilink cubes) to show the pattern for all of the facts for 8; for example:



1 + 7 = 8
2 + 6 = 8
3 + 5 = 8

Paper and Pencil

C5.2 Ask the student to continue the pattern.

4 + 3 = 7
5 + 3 = 8
☐ + 3 = ☐
☐ + 3 = ☐

C5.3 Ask the student to list all the pairs of numbers that can be added for a total of 4, then repeat the process for totals of 5 and 6. Have him/her arrange the lists so that the first number increases by one each time. Ask: What is the pattern?

Interview

C5.4 Ask the student to tell how many facts are in a fact family and why people think there is a pattern to fact families.

Suggested Resources

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 grade 1, students will be expected to

D1 identify procedures (not involving units) to compare and/or order lengths, capacities, and areas

A developmentally appropriate curriculum . . . incorporates real-world contexts, children's experiences, and children's language in developing ideas. It recognizes that children need considerable time to construct sound understandings and develop the ability to reason and communicate mathematically. (Curriculum and Evaluation Standards, p. 16)

Elaboration - Instructional Strategies/Suggestions

D1 Children should recognize that length tells about the extent of an object along one dimension. Initially, they would compare lengths informally by simply viewing the two lengths. Later, they should investigate strategies to compare the lengths of two or more objects in situations involving both direct and indirect measurement.

- Direct measurement consists of comparing lengths by lining up items side by side, beginning at a common base. (Note: Students should be led to see why a common starting point is important.)
- Indirect measurement consists of comparing lengths when it is not possible to physically line up the objects. For example, to compare length of hand to wrist size, students might cut pieces of string the length of their hands, and then wind the strings around their wrists for comparison.

Children should order objects from longest to shortest. Include situations in which students are dealing with an extraneous variable, such as objects

- which are not straight
- which are also wide or thick

Students should meet a variety of words involving the measurement of length, including "longer," "taller," "wider," etc. In every measurement situation, the focus should be on answering real questions (e.g., Which finger is longest?).

Children should recognize that capacity tells how much something will hold. They should investigate strategies to compare the capacities of two or more containers. Initially, however, they would be expected to compare informally by simply viewing the containers. Encourage the students to share their estimating strategies. Again, include situations in which students measure directly and indirectly.

- Direct measurement involves filling one container and then pouring the contents into another to find which holds more.
- Indirect measurement involves comparing the capacities of each of two containers to that of a third referent. For example:
  B holds more than A;
  C holds more than B;
  so C holds more than A.

Provide opportunities for students to order the capacities of a number of containers, as well as opportunities for students to select the container most appropriate to hold a particular item.

In comparing areas, students are examining the amount of space taken up by an object. For example, one placemat might take up more of the table than another.

- Direct measurement involves placing one surface on top of another to see which "sticks out."
- Indirect measurement involves comparing the areas to a third area.

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 the student with 3 containers (of various shapes) and filling material (e.g., beans, styrofoam packing material). Ask the student to order the containers based on how much they hold.

D1.2 Provide students with "trains" of various lengths made from interlocking cubes. Ask them to order the trains from shortest to longest.

D1.3 Provide some hexagonal, or square, pattern blocks. Have students decide which of two spaces can be covered by the fewer number of blocks.

D1.4 Ask two children to perform standing long jumps. Encourage them to find a way to determine who jumped farther. Stress with the students the importance of a common starting point.

Interview

D1.5 Place a longer, curved piece of string beside a shorter, straight piece.

Ask: Which is longer? Why?

D1.6 Ask the student to show, without using a ruler, how he/she could find out which is wider, the door or the window.

D1.7 Ask: How would you decide whether or not your thumb is shorter than your other fingers?

D1.8 Ask: What does "holds more" mean? Have the student explain his/her thinking.

Presentation

D1.9 Have students prepare a set of ribbons for first, second, and third places in a race, so that the faster runner gets a longer ribbon.

D1.10 Show the students a coffee mug and a drinking glass. Ask them to decide whether a coffee mug usually holds more or less liquid than a drinking glass.

Suggested Resources

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 grade 1, students will be expected to

D2 identify procedures (not involving units) to compare and/or order masses and durations of time

The purpose of an interview is to uncover how students think about mathematics, so provide opportunities for contradictions in students' beliefs about mathematical concepts to emerge. (Mathematics Assessment, p.29)

Elaboration - Instructional Strategies/Suggestions

D2 Students should recognize that mass tells about the "heaviness" of an object. They should explore methods to compare and order masses, including situations involving both direct and indirect measurement.

- Direct measurement involves, for instance, placing two objects on a balance simultaneously and comparing the mass of one with that of the other.
- Indirect measurement involves comparing the masses of two objects by using another object as a referent.

Children should explore methods to compare and order lengths of time. This aspect of measuring time should be distinguished from the act of reading a clock, which is an important, but different, skill. Include, once again, situations involving both direct and indirect measurement.

- Direct measurement would involve beginning two or more actions at the same time, to see which takes longer.
- Indirect measurement occurs when two actions are independently compared to a third action. For example, it takes longer to tie my shoes than to say my complete name; it takes longer to say my complete name than to clap twice; so it takes longer to tie my shoes than to clap twice.

Students should be exposed to, and use, a broad measurement vocabulary. For example, they should hear and use words such as

- heavier, lighter, has the same mass
- takes longer, lasts the same amount of time

Students should also recognize that

- objects of different volume can have the same mass (e.g., a large piece of styrofoam and a small plastic item)
- the mass of objects can be deceiving (e.g., a small iron ball can be heavy)

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 Have the student make a playdough ball, then make another with an estimated mass one-half as much as the first. The student then checks for the accuracy of the estimate.

D2.2 Ask the student to decide if it takes longer to clean out a school desk or eat an apple.

D2.3 Ask the students to predict whether it takes more time to print their first or last name, and then to show how they could find out for certain.

D2.4 Display a set of five objects of similar size and a sixth target object. Ask the student to sort them into groups with masses less than and greater than the target.

Interview

D2.5 Ask the student to explain how he/she could find out who is the fastest runner in the class.

D2.6 Show a pan balance and two items. Ask the student how to use the balance to find out which item has the greater mass.

D2.7 Ask the student to explain how to compare the mass of an item at home with one at school, if he/she cannot transport either item.

Presentation

D2.8 It would be valuable for students to participate in "dramas" in which someone measures incorrectly and the other students have to figure out what is wrong. For example, one student could play a part in which he/she lines up pencils of different lengths to measure an item, or uses uniform units, but counts, "1, 2, 4, 5..."

Suggested Resources

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

ii) identify and use non-standard and standard units of measurement and appreciate their role in communication and

iii) estimate and determine measurements in everyday problem situations and develop a sense of the relative size of units

SCO: By the end of grade 1, students will be expected to

D3 identify and use non-standard units to estimate and measure length, capacity, time, mass, and area

D4 read hours on an analog clock

Informal [non-standard] units make it easier to focus directly on the attribute being measured. (Elementary School Mathematics, p. 293)

Elaboration - Instructional Strategies/Suggestions

D3 Students should

- estimate and measure objects in non-standard units for the purpose of answering relevant and practical questions; for example, do people with longer legs usually jump farther?
- be encouraged to determine what unit might be appropriate in a given situation; for example, would I measure the capacity of a punch bowl with a thimble?
- sometimes use the same non-standard unit to measure a variety of items in order to compare them; for example, how many wooden blocks would balance a sneaker? a book? a grapefruit?
- sometimes measure the same object with different non-standard units to see how the quantities vary; for example, how many triangle pattern blocks cover a space? how many square blocks cover the space?

Other possibilities for measuring include

- finger widths, eraser lengths, hand spans, foot lengths, paces, and paper clips to measure length

❒ Students might search for items that are a given number of paper clips long.

- cups, spoons, boxes, and bags to measure capacity

❒ Students might decide how many cans of apple juice are required to fill a cup for each student in the class.

- sand timers, claps, counting, and water clocks might be used to measure time

❒ Students might determine how many times one can sing "Row, Row, Row Your Boat" while doing 50 jumping jacks.

- pennies, marbles, and linking cubes might be used to measure mass

❒ Students might estimate the number of pennies needed to balance a granola bar.

- pattern blocks, postage stamps, and bread tags might be used to measure area

❒ Students might estimate the number of stamps to cover an envelope.

Some further considerations:

- Students should become accustomed to estimating before measuring, and subsequently comparing the estimate and the measurement.
- Students should realize that the smaller the unit used for a measurement, the more units that will be needed, and vice versa.
- As illustrated in the examples above, measurements should be performed in situations which are relevant to the students.

D4 Analog clock reading should begin with a focus on hours only. (Having students work with one-handed clocks is a useful way to begin this.) Times should be stated in terms of hours only, but using approximate language such as "a little past seven o'clock" or "between eight and nine o'clock."

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

D3.1 Provide a small jar with 10 marbles in it and indicate how many there are. Ask the student to estimate how many marbles it would take to fill the jar and then check the estimate.

D3.2 Ask a student to use linking cubes to measure the distance toy cars travel when rolled down a ramp.

D3.3 Provide students with cookie cutters and some dough. Ask them to spread the dough and estimate how many cookies could be cut from it.

D4.1 Present a number of routine daily events (e.g., waking up, recess, supper, bus departure from school). Ask the student to position the hand of a one-handed clock appropriately for each event, and to state the time (to the nearest hour, using approximate language) in each case.

Paper and Pencil

D3.4 Ask students to write or draw something that would explain why a book is not a good length unit.

D3.5 Ask students to select a pattern block to cover a sheet of paper in order to find its area. Discuss why different students might have different answers.

Interview

D3.6 Ask the student to explain how he/she could find out who is the fastest runner in the class.

D4.2 Present the student with a time shown on a one-handed analog clock. Ask him/her to read the time to the nearest hour and to name an event/activity that often happens at about that time of day.

Portfolio

D3.7 Ask the students to choose a particular mass, for example, the mass of 10 pennies or 5 marbles. Have them identify a variety of items with that mass and organize their findings for a portfolio entry.

Suggested Resources

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 grade 1, students will be expected to

E1 develop aspects of spatial sense, including visual memory

Spatial sense involves perceptual abilities that are important for early school success. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 19)

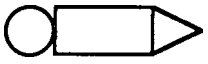
Elaboration - Instructional Strategies/Suggestions

E1 While this outcome particularly focusses on visual memory, instruction must provide for the continuation of the development of all spatial skills. Those specifically addressed in kindergarten must be supported again at this level.

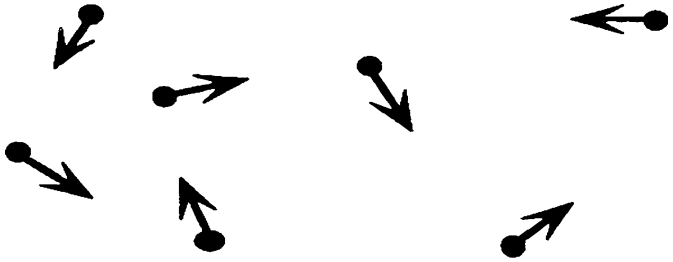
Visual memory is the ability to recall objects no longer in view. For example, students should be asked to draw a triangle to see if they remember what triangles look like. Other times they might be shown a shape for a short time and then asked to reproduce it. Seeing a simple pattern and continuing this pattern from memory also requires visual memory skills.

Students have had experiences with a number of 2-D shapes, and most will have developed visual representations for the more common ones.

- ❒ Ask the students to make a shape (a triangle or a square, for example) on their geoboards. Have them compare their shapes with those of others in their groups. Then ask them to turn their geoboards around, viewing their shapes from a different perspective. Discussion should follow concerning these "new" shapes. Are they still triangles? squares? Is there any way one could turn the geoboard so they would not be triangles? squares?
- ❒ Make a shape on a regular, or overhead, geoboard (a right triangle, for example). Allow the students 10 seconds to examine the shape. Ask them to then copy this shape on their own geoboards. (As with many of these activities, it is important for the students to share their shapes and to justify their answers, particularly if they differ from others. Early work in this area would be with simple shapes and would become more complex as the students develop.)
- ❒ Show designs on a card or overhead for a few seconds and ask the students to draw them from memory; for example,



- ❒ To provide practice in eye-motor coordination (as addressed in kindergarten), have the students follow directional arrows to create a shape; for example,



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

Worthwhile Tasks for Instruction and/or Assessment

Performance

E1.1 Make a triangle on a geoboard. Make a very different triangle on the same board. Ask: Are they the same shape? Why or why not? How are they alike? How do they differ? Invite the student to make yet another triangle on his/her geoboard that looks different from both the other two. Encourage him/her to talk about the similarities and differences among the triangles.

E1.2 Provide the student with 3 shapes. Use a second set of the same 3 shapes (e.g., a rectangle, a hexagon, and a triangle) and create a design. Have the student reproduce the design. Then move one of the shapes to a new position relative to the others and again ask the student to reproduce it. Observe which task the student finds easier and whether the relative positions of the shapes makes a difference.

Paper and Pencil

E1.3 Show a shape for 10 seconds (on a geoboard, for example) and ask the student to copy the shape he/she remembers seeing.

E1.4 Show the student a design made from a combination of objects (pencils, erasers, buttons, counters). Allow sufficient time for him/her to get a visual representation of the design. Ask the student to reproduce the design when it is hidden from view. The following design would serve as an example.

Presentation

E1.5 Invite pairs of students to use four building blocks to make a shape behind a barrier. Ask them to remove the barrier so that the class can see the shape for a specified number of seconds before making the same shape. Have the two students check their classmates' work.

- ❒ To assess the students' development in the "position-in-space" skill (as presented in the kindergarten document), provide opportunities for the student to reproduce structures built from materials (wooden block shapes, for example). Many may be able to proceed to reproducing simple structures from a pictorial model.
- ❒ The following activity with pattern blocks also provides practice in the position-in-space skill. Give directions to the student, using spatial language; for example: Place a yellow shape to the left of a red one. Put another yellow shape above the red one. Place a green shape below the red one.

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

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

SCO: By the end of grade 1, students will be expected to

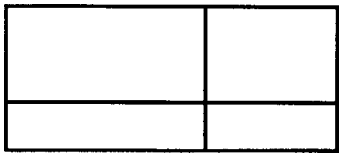
E2 develop aspects of spatial sense, including figure-ground perception

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

E2 Figure-ground perception is the visual act of identifying a figure against a complex background. This skill, like all spatial skills, will develop through experiences and over time.

- ❒ Provide a large (posterboard size) laminated picture made of a number of overlapping shapes. Ask the students to find, and outline with a washable marker, a particular shape whenever it appears in the picture.
- ❒ Use different coloured elastics to make several overlapping shapes (e.g., triangles, squares, rectangles, hexagons) on a geoboard. Ask students to find specific figures and to trace over them with their fingers. As an extension, have students make overlapping shapes and exchange their boards with classmates to see if they can find particular shapes.
- ❒ An activity that involves figure-ground perception is the assembling of parts to make a whole. Ask the student to reassemble a rectangle that has been cut along one, or both, diagonals.
- ❒ Ask students how many rectangles they can see in a given diagram; for example,



The use of 5 x 5 (rather than 10 x 10) geoboards is highly recommended for children at this age.

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 enter grade one with a great deal of experience, while others have had little experience at all. Selected puzzles should challenge all students.

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

Worthwhile Tasks for Instruction and/or Assessment

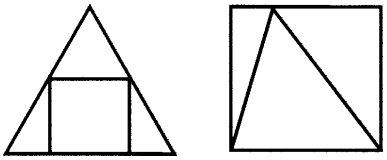
Performance

E2.1 Provide a laminated picture of a number of shapes. Ask the student to trace over the rectangles with a washable marker. Change marker colours to trace different shapes.

E2.2 Show the student a picture that includes objects of many different shapes. Ask him/her to point out examples of one type of shape (e.g., triangle).

Interview

E2.3 Show the student pictures as below:



Ask the student what shape(s) he/she sees.

Observation

E2.4 Provide a multi-coloured shape drawing. Have students look for particular shapes (e.g., triangles). Observe whether the shape's colour and/or background colours affect their ability to recognize shapes.

Paper and Pencil

E2.5 Give the student a prepared collage of overlapping shapes. Ask him/her to follow, or create, a colour code for tracing over particular shapes; for example, trace over all triangles in red, rectangles in blue.

Portfolio

E2.6 Ask students to each make a picture of overlapping shapes on plain paper. (Some may wish to trace around commercial materials, such as attribute blocks. Some may be able to use a straight edge to connect dots on geopaper to make the shapes; this would require more developed eye/hand and fine motor skills.) Before filing the pictures in their portfolios, have the students exchange pictures and take part in shape searches as a group.

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

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

SCO: By the end of grade 1, students will be expected to

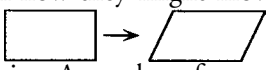
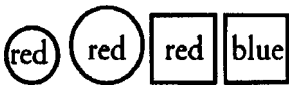
E3 sort, build and pattern with 2-D and 3-D shapes

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 Students in the early grades need many varied opportunities to manipulate both 2-D and 3-D shapes. Activities in which they sort, make and recognize patterns, build shapes, and talk about what is happening help to develop essential geometric skills. It is through such activities that students will learn the names of 2-D and 3-D shapes and begin to recognize their characteristics.

Sorting activities help to develop visual discrimination. It is important to encourage students to look for alternative ways of sorting; this necessitates the further investigation of objects.

- Ask students to bring to school one object that is round. Provide some time for students to talk in groups about what they brought, discussing how they would sort the objects. (The common sorting rule that "some are round like a cylinder, others are round like a ball" should capture most of the shapes collected; however, if a student has brought a 2-D shape, such as a happy face sticker, it would be part of a third group in the sorting.)
- Provide an assortment of 2-D shapes cut from tagboard. Ask students to work in small groups to sort the shapes. Encourage discussion and have the groups share their sorting rules with their classmates.
- Ask students to use modelling clay to build 3-D models.
- Invite students to build shapes with pipe cleaners (or pipe cleaners and straws). Have them make a 4-sided shape and ask how they might move the sides to form a new shape, for example, 
- Patterning with breakfast cereal is a worthwhile activity. A number of dry cereals have square, rectangular, circular, and other shapes.
- Attribute blocks provide opportunities for students to work with 2-D shapes to continue or to create patterns (e.g., large, red, thick triangle; small, blue, thin circle). It is important that children are encouraged to verbalize the attributes.
- An activity that students enjoy is making difference trains. Ask students to use attribute blocks to make a train, using a pattern of one (two or more) differences; for example, 

Provide students with many opportunities to work together building with different materials. It is important that they discuss their constructions and learn from each other. Sometimes their projects may take days to complete and will have to be protected from destruction.

Provide opportunities for students to build 2-D and 3-D shapes by following oral directions: "Place the cube between the small cylinder and the cone and place the large cylinder behind the cube," for example. Invite students to make their own designs and then challenge their classmates to build the same structure from their oral directions.

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

E3.1 Provide several different 3-D shapes. Ask the student to sort them and to explain the sorting criteria. Ask him/her to sort them again, using different criteria.

E3.2 Make an assortment of 2-D shapes from posterboard. Ask the student to sort them and to give the sorting rule.

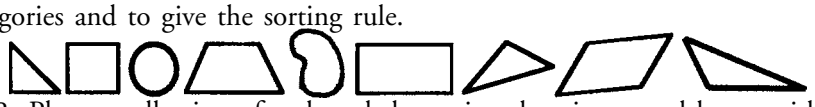
E3.3 Provide 4 blocks. Ask the student to build as many different structures as possible.

E3.4 Have the student build a structure with about the same width as height.

E3.5 Have the students cut out many different sizes and shapes of one figure (e.g., triangles). Ask them to use these shapes to design an alien. Encourage them to describe their aliens.

E3.6 Provide the student with a collection of solids and pictures of constructions. Ask: Which of the pictures show constructions that could be built with the available solids?

E3.7 Ask the students to work in pairs to sort the shapes below into two categories and to give the sorting rule.



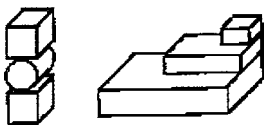
E3.8 Place a collection of tagboard shapes in a baggie to send home with the student. Include directions, asking him/her to sort the shapes and to write down the sorting rule(s) (adult assistance may be required). A further activity would be to have the student make a larger shape by combining these smaller shapes. Ask that the new shape be traced so that other students may be challenged to fill in the shape puzzle.

E3.9 Ask students to make class books shaped like a triangle, a square and a circle. Have them fill each book with pictures (cut out or drawn) of objects that have the same shape as the book.

Interview

E3.10 Have the student make a bridge from building blocks and ask him/her to tell about the construction. Ask: Why were these particular blocks selected? Could different blocks have been used? How strong is the construction?

E3.11 Provide 3-D shapes. Display pictures of possible constructions. Ask: Which of these will topple? Build the one that will not topple.



Portfolio

E3.12 Ask students to cut pictures from magazines of things that can be sorted according to shape. Display the sorted and labelled collections before placing them in their portfolios.

Suggested Resources

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

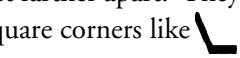
KSCO: By the end of grade 3, students will be expected to

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

SCO: By the end of grade 1, students will be expected to

E4 recognize and represent angles

Elaboration - Instructional Strategies/Suggestions

E4 It is important for students to be able to recognize shapes in their world. To do this they will need to identify the attributes of those shapes. Through investigation, students will note that some shapes have sides that come together to form corners – it is these "corners" that students are expected to explore at this level. There is no intent at this level, however, for students to identify angles by naming them or discussing degree size. Some may be comfortable using the term "angle," others may prefer "corners," while still others may use the two terms interchangeably. There is no expectation that students at this age will understand the concept of angle size remaining the same as the angle rays get farther apart. They could, however, compare sharp corners like  and square corners like  to wide corners like  .

- ❒ Have the students compare the corners of large (15cm sides) cutout shapes; for example, ask them to work in pairs comparing the angles of a square to those of a rhombus.
- ❒ Ask students to find angles in the classroom that are different from the "square" angles that are most common.
- ❒ Provide a "square corner" or "square angle" template made from sturdy paper. Have the students work with the templates in pairs to make a list of things in the classroom that have these corners, as well as a list of things that have different-shaped corners. It would be worthwhile to ask them to compile their data, compare the two lists and to discuss why the "square corner" list is longer.
- ❒ Have students double up their bodies, or use their legs, arms and hands to form angles. They could note whether or not the angles are sharp, almost square, wide, etc.
- ❒ Give the students commercial geostrips, or those made of heavy card board and paper fasteners. Ask them to show an angle and say, "Can you make it wider (sharper)?"

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

E4.1 Show the student an angle in a particular 2-D shape. Ask him/her to select another shape that has an angle similar in size and to justify the selection.

E4.2 Ask the student to draw a shape with a lot of sharp angles or a shape with some wide angles.

Interview

E4.3 Ask the student to choose a block from the pattern-block kit and to tell you about the angles.

Portfolio

E4.4 Have the students select a 2-D shape from among familiar geometric shapes. Ask them to write about the different angles that make up this shape and to compare their findings with those of a fellow student who selected the same shape. They may be encouraged to represent the angles in different ways – sketching, tracing, making a chart, graphing.

E4.5 Have pairs of students use angle templates and go on an "angle search" around the school. Ask them to report their findings to the class and prepare a written report for a classroom display.

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

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

SCO: By the end of grade 1, students will be expected to

E5 recognize, name, describe, and represent a variety of 2-D and 3-D shapes

Elaboration - Instructional Strategies/Suggestions

E5 Students' previous experiences with 2-D shapes would include, but not be limited to, square, triangle, circle and rectangle. As pattern blocks are regularly used for geometric inquiry, it would seem reasonable that students become familiar with the terms rhombus, trapezoid, and hexagon as well.

Through experiences with their building blocks, students should be comfortable using such terms as cylinder, sphere, cone, and cube. Students should be encouraged to use accurate geometric terminology. By the end of grade one, students' vocabulary should include rectangular prism, triangular prism, triangular pyramid, and square pyramid.

Prisms are special shapes that have identical polygons as bases and rectangular sides; the type of base is the name given to the prism. A rectangular prism has rectangles as bases, a triangular prism has triangles as bases. Ask students to stack a number of pattern-, logic-, or attribute-block triangles to make a triangular prism, rectangles to make a rectangular prism, and hexagons to make a hexagonal prism. Have them find the matching 3-D blocks.

Pyramids have a polygon as a base, and the sides come together to a point. All sides of pyramids are triangular except the base (the one exception being the triangular-based pyramid).

Students at this level should understand the concept of prism and pyramid and be able to distinguish between the two. It is not expected that they will be able to name many specific prisms or pyramids. The focus at this level is primarily exploration.

- Place three 3-D shapes in a bag, two of which are the same and one different. Invite students to feel the shapes inside the bag to identify the odd one and to tell how it is different. A similar activity, using firm 2-D shapes, can be used as well.
- As a problem-solving activity, ask the students to make (on a geoboard) a triangle that has 2 pegs inside, then one that has three. Ask: What is the greatest number of pegs that can be inside a triangle on a geoboard? Repeat this activity with other shapes.
- Ask students to look for containers that are shaped like some of the prisms they explore with their blocks.
- Shape Pricing – Ask students to determine the value of each of a collection of 3-D shapes if
  - each triangular face is worth 1 cent
  - each square face is worth 2 cents
  - each rectangular face is worth 3 cents

  Encourage the students to first estimate which will be more valuable and to give their reasons.

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

E5.1 Have the student select from a collection of 3-D shapes one that is made up of only one kind of face.

E5.2 Place three 3-D shapes in a bag, two of which are the same. Ask the student to feel the shapes inside the bag to identify the odd one and tell why it does not belong.

E5.3 Place a number of different 2-D, or 3-D, shapes in a bag. Name (or show) a particular shape for the student and ask that he/she locate it by feeling the shapes within the bag.

E5.4 Show the student a trapezoid and ask him/her to reproduce the shape on a geoboard. Ask: What is the shape? Explain how you know.

E5.5 Give the following geoboard assignments to the student: Make a shape with four sides that touches 9 pegs. Make the smallest triangle (square, rectangle) and the biggest triangle (square, rectangle) that you can. Make 4 triangles that overlap.

E5.6 Play a game of "Attribute Block Riddles." Divide a set of attribute blocks among students in a group. Give them a set of cards with riddles on them, such as
My block is blue.
It has three sides.
It is large.
It is thin.
As a block is identified, the player places it back in the box. The winner is the first one to get rid of all his/her blocks.

E5.7 Have the students work in pairs with a geoboard to make a large square with a smaller square inside it.

Paper and Pencil

E5.8 Ask the student to circle all the triangles that she/he can find in the following set of shapes. Ask her/him to give reasons for the selections and to explain why some did not belong.

Interview

E5.9 Provide a cylinder and a cone. Ask the student to describe how they are alike and how they differ.

E5.10 Ask the student to explain how a cube and a square prism are the same and how they are different.

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

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

SCO: By the end of grade 1, students will be expected to

E6 describe attributes of and sort and compare 2-D and 3-D shapes

Elaboration - Instructional Strategies/Suggestions

E6 Students should be encouraged to observe the attributes of many shapes. Describing shapes allows children to focus on their basic characteristics. Use questioning to focus student thinking; for example:

- What other shapes are similar to this one? In what way are they alike?
- What does this object look like?
- Is the object long? tall?
- Does the object roll or stack?
- Pick two of the shapes and tell how they are alike and how they differ.

It is important for teachers to model geometric language; however, terms such as "cylinder," "sphere" and "cone" should be interspersed with natural language such as "can," "ball," etc.

Considering the attributes of various 2-D and 3-D shapes allows students to compare them and sort them, using first one, then another attribute as the sorting criteria.

❒ Provide students with the large triangle, square, and rectangle of an attribute-block set. Ask them to work in pairs, comparing the three shapes, and listing all the ways in which they are the same and how they differ. They should be able to properly identify the shapes and to compare such things as number of sides, length of sides, and angle size.

❒ Collect cylinders of different sizes. Ask the students to estimate and order them according to size, smallest to greatest. Have them investigate the relative sizes, using foam packing "peanuts" or pasta to measure. Invite them to write about their findings. The same investigation will work well for a variety of box sizes.

❒ Have students make mobiles of 2- and 3-D shapes based on some prescribed attributes.

❒ Ask the students to paint and decorate boxes, cans, balls and cones. These can be used for storage, decorations, gifts, and party hats. Ask them to determine how much wrapping paper they should cut to wrap boxes so as not to waste too much paper.

❒ Give children a set of shapes (e.g., prisms and pyramids placed randomly and toppled) and ask them to sort them into two groups. Observe whether or not separating prisms from pyramids is their natural sorting criteria.

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 the student to compare 3-D shapes to determine which rolls best - a sphere, cylinder, or cone.

E6.2 Provide students with a collection of 3-D shapes. Give clues and ask them to pick the shape. For example: It will roll. It will stack. OR One side is flat. It won't stack. Have the students give their own clues to their group.

E6.3 Provide the student with a large paper triangle. Ask him/her to fold it so it looks like a cone.

Interview

E6.4 Provide a cylinder and a cone, or a cube and a rectangular prism. Ask the student to describe how they are alike and how they are different.

E6.5 Present 2 rectangular prisms, one of which is a lot longer than the other. Ask: Are these the same shape or different shapes? Why?

E6.6 Ask the student to name solids that have only flat faces and some that do not.

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

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

SCO: By the end of grade 1, students will be expected to

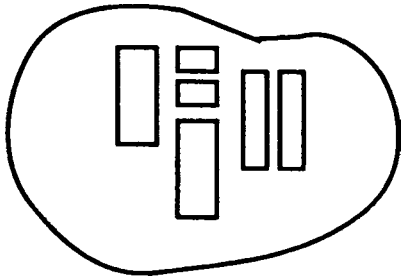
E7 **recognize 2-D figures in 3-D shapes**

Elaboration - Instructional Strategies/Suggestions

E7 Students should become familiar with the 2-D shapes that are the faces of 3-D shapes. They can describe

- many solids with a particular shape as a face
- all the shapes making up the faces of a given 3-D shape

❒ Students can press each face of a solid into plasticine to get a "map" of the solid.



❒ Place a 3-D shape on the overhead projector and ask students to predict what shape they will see when the projector is turned on. Students might project onto paper and trace around the image.

❒ Give students a combination of 2-D and 3-D shapes. Ask them to investigate which of the 2-D shapes appears most often as a face of a 3-D shape. Have them make a graph to display their findings.

❒ Students might discuss why a circle is not a "face" of a sphere.

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

E7.1 Provide the student with several 3-D shapes. Show a set of faces such as

Ask the student to match the set of faces to the corresponding 3-D shape.

E7.2 Make a "map" of a 3-D shape in plasticine or the sand box. (See the example at right.) Ask the student to select the matching shape.

E7.3 Show the student a rectangular prism and ask him/her to draw the shapes that are the faces.

Paper and Pencil

E7.4 Ask the student to draw the shapes that are the faces of a square pyramid.

E7.5 Ask the student to draw the shape he/she thinks most often appears as a face of a 3-D shape and to explain why.

Interview

E7.6 Ask the student to name the 3-D shapes that have a circle as one of their faces.

E7.7 Ask the student to select from a collection of 3-D shapes one that is made up of only one kind of face.

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

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

SCO: By the end of grade 1, students will be expected to

E8 build, divide, and change 2-D shapes

Elaboration - Instructional Strategies/Suggestions

E8 Activities selected in geometry should provide students with the opportunity to explore. They need to see and feel, to build and take apart, and to share their observations with their classmates. They must feel free to experiment and to take risks.

- Have students make a large (5 x 5) square on a geoboard. Ask them to use another elastic to divide the square into two equal parts. How many ways are they able to find? (They should be able to divide horizontally, vertically, and on both diagonals. Some will be able to discover many other ways.)
- Provide students with square pieces of paper. Ask them to fold the paper so that there are two equal parts. Have them share their work.
- Show students a collection of half-squares and ask them to match each with its other half. Some pairs might be shapes other than triangles or rectangles.

- Ask students to cut a square, rectangle, or triangle into three parts. Have them exchange their pieces and ask their partner to rearrange them to make the original shape. (Activities such as these, in which a student is required to assemble a figure from its parts, further develop figure-ground perception skills.)

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

E8.1 Divide each of two triangles into two parts. Give the four parts (in random order) to the student and ask if he/she can make two triangles out of them. Encourage the student to explain how he/she knew which pieces to put together.

E8.2 Ask the student to watch as you cut a rectangle along the diagonal. Have him/her reassemble it and ask if there is another shape that can be made with the pieces.

E8.3 Ask the student to cut a square along the diagonal and to see if he/she can make a different shape with the pieces.

Interview

E8.4 Show the student an isosceles triangle that has been folded in half. Ask the student to tell what it will look like when it is unfolded.

E8.5 Show the student a rectangle and ask: If I were to cut this rectangle along the diagonal, from one corner to another, what shapes would I have?

E8.6 Show the student a square that has been folded along the diagonal. Ask: What shape will this be when I unfold it?

Portfolio

E8.7 Have students tape record their own story about a shape that keeps changing.

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

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

SCO: By the end of grade 1, students will be expected to

E9 recognize, name, describe, and represent slides and reflections of 2-D shapes

Elaboration - Instructional Strategies/Suggestions

E9 Much of students' geometric development depends on understanding how shapes do and do not change when they are transformed in different ways. Two important transformations are slides and reflections (flips). Students should develop intuitive notions that a slide moves a shape up or down, right or left without changing its orientation. A flip has the effect of reversing a shape (i.e., "right" becomes "left" or "up" becomes "down").

To describe slides, students might use informal language such as "up and to the right" or "over a lot and up a little." To describe flips, students should be able to use language such as "flipped up" or "flipped to the left."

- ❒ Have children follow a set of instructions for creating pattern-block pictures. For example: Put down a square. Trace around it. Slide it a little to the right and a little down. Trace around it. Slide it down a little more and a little to the left. Trace around it. As they observe each other's designs, they might notice certain things are the same and other things are different. Encourage discussion.
- ❒ Place two strips of masking tape about 10 cm apart on a table top. Give a pair of students some pattern blocks to make designs. One student makes a design on one side; the partner makes the mirror image on his/her side. (The opportunity to use a Mira or mirror would be worthwhile.) You may wish for them to place one block at a time and then its reflection. Encourage the students to use "position-in-space" language such as right, left, on top of, in front of, and behind.
- ❒ The following introductory activity will encourage students to use "position-in-space" language. Place a barrier on a table between two children. One child makes a construction with two, three, four, or five 3-D shapes. His/Her task is to communicate to the partner how the construction can be replicated as a mirror image. (A difficult concept is the recognition that "right" to one person is "left" to a facing partner. This is why it is important to start with only two or three shapes.)
- ❒ Provide students with a sheet of paper filled with triangles in different positions. (Some should be different triangles altogether.) Also provide a cut-out of the triangle in the upper left corner. Have the students flip and slide the cut-out to see what matches they can find and describe each match as a flip or slide of the one in the upper left corner.

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

Worthwhile Tasks for Instruction and/or Assessment

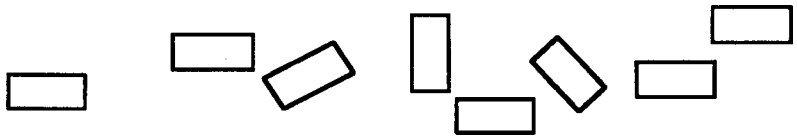
Performance

E9.1 Give each of a pair of students the same set of pattern blocks. Ask one of the pair to create a design. Have both students look at the mirror image of the design. Then remove the mirror and ask the students to recreate the mirror image. Ask: How might a mirror be used to help one see if the designs are mirror images of each other?

E9.2 Give the student a Mira. Ask him/her to place two pattern blocks on one side and to use the Mira to place identical blocks on the reflection. Observe how adept the child is at finding the placement.

E9.3 Give the student a pattern-block hexagon. Have him/her show a slide.

E9.4 Show the student a shape. Provide a picture of a number of shapes and ask the student to identify all that are slides of the original shape.



Paper and Pencil

E9.5 For some students, the following activity provides practice in eye-hand coordination; others whose skill in this area has not sufficiently developed to this point would find it frustrating.

Place two pattern blocks together (a hexagon attached to a trapezoid, for example) on one side of the Mira and ask the student to trace over its reflection on the other side.

Interview

E9.6 Place two squares as shown below:

Ask: Do you think a slide or flip happened? Explain your thinking. Why is it hard to tell?

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 grade 1, students will be expected to

E10 recognize and identify 2-D and 3-D shapes in the environment

E11 cover figures and fill shapes with countable non-standard units

. . . Informality should be the keystone of early geometry experiences. Children have observed geometry in their world since birth and have already acquired some strong ideas that need to be explored for validity. Hence a variety of experiences investigating and discussing geometric concepts in different contexts is needed. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 19)

Elaboration - Instructional Strategies/Suggestions

E10 Students should become familiar with the variety of sizes and proportions possible for circles, rectangles, triangles, squares, hexagons, etc. by observing these 2-D shapes in their surroundings. Children should also recognize 3-D shapes in their environment. These real-world associations are most important in the development of geometric concepts.

Include activities in which students are required to find shapes in
- pictures of objects
- their environment

❒ Invite children to hunt around the school to find various shapes (e.g., trapezoids, squares, triangles). Have them share their findings and speculate on why certain shapes are more common than others.

While students will be having experiences with many 2-D shapes, by the end of grade one they should be comfortable with the following geometric terminology: rhombus (diamond), trapezoid, and hexagon, as well as rectangle, square, triangle, and circle.

E11 Students at this age enjoy filling in picture outlines with various 2-D shapes. Often the assignments are challenging and serve as ideal problem-solving activities. Many commercial materials include pictures with instructions for the student. For example: Fill the picture in with as many blocks as you can. Can you fill the picture using just one type of block? How many different ways can you fill in this shape? Can you fill in this shape with exactly seven blocks?

These are all early area investigations and a focus at this level should be on estimation – looking at the non-standard units, the picture to be filled in, and attempting to name a reasonable number of units that would cover the area.

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

Worthwhile Tasks for Instruction and/or Assessment

Performance

E10.1 Ask the student to sort by shape a collection of pictures of common objects, and to describe the reasons for his/her sortings.

E10.2 Ask the student to examine containers such as one used for yogurt or cottage cheese. Ask: Are these cylinders? How do you know?

E11.1 Give the student an outline of an animal. Ask him/her to find the fewest number of pattern blocks that will fill the picture.

E11.2 Ask the student to make a shape, using eight pattern blocks. Trace around the shape or have the student do the tracing. Challenge other students to fill in the shape, using eight blocks.

Paper and Pencil

E10.3 Ask the student to describe or draw some of the different kinds of triangles that she/he sees.

E10.4 Have the students draw a picture of something in their world that includes lots of squares and circles.

Interview

E10.5 Show a triangle. Ask the student to find three things in the classroom that make him/her think of that shape.

E10.6 Ask: Where might you see a hexagon?

E10.7 Ask: What makes a circle a special shape? Can you think of something that is circular that would work just as well as a different shape?

E10.8 Find pictures of bridge supports. Ask: What shapes seem to be prominent?

Suggested Resources

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 grade 1, students will be expected to

F1 collect and organize data

First grade is a wonderful time to help children make sense of data. Often more new information is presented at this grade level than at any other. As children learn to sort and organize, they develop extremely useful skills that will help them deal with the vast amount of information they will learn during their school years. (Curriculum and Evaluation Standards, Addenda Series, First-Grade Book, p. 13)

Elaboration - Instructional Strategies/Suggestions

F1 Students should be encouraged to organize and interpret data discovered in the course of classroom investigations. Data might be tallied or organized into charts. This is a good time for students to apply the traditional tallying process (e.g., 𝍸 𝍸 || represents 12) since it provides a context both for skip counting (SCO A3) and benchmarks (SCO B7).

Collected data might involve information about

- solids and shapes
- addition by groups such as sums < 5, sums > 5
- capacities of various containers
- results of probability experiments, such as coin flips
- classroom demographics, such as hair colour
- personal likes and dislikes
- types of pets
- etc.

❒ Students should be encouraged to conduct small surveys to collect data.

❒ Students might collect data to determine whether more addition facts have a sum less than 10 or greater than 10. (Note: Addition facts refer to those additions for which both addends are less than 10. Subtraction facts are the corresponding subtractions.)

❒ Students might collect data to determine the most commonly preferred fruit or vegetable.

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 Have the students make a chart to show which colours the children in their group are wearing and how many are wearing each colour.

F1.2 Ask the students to sort the addition facts into two groups. They should explain their sorting rule and tell how many facts are in each category.

Interview

F1.3 Give the students some red, yellow, and blue blocks randomly organized. Ask how they would reorganize them to tell very quickly how many of each colour there are.

R B
R Y
R Y Y

F1.4 Have the student explain what the following might mean:

RED HAIR -
BROWN HAIR -
BLONDE HAIR -
BLACK HAIR -

F1.5 Ask the student how he/she might find out whether more children wore gloves or mittens to school.

Presentation

F1.6 Ask small groups to devise a way to find out the favourite colour of each teacher in the school (students in a class). Invite them to present their findings to the class and explain how they organized their information.

Suggested Resources

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 and

iii) read and interpret displays of relevant data

SCO: By the end of grade 1, students will be expected to

F2 interpret and create concrete and picture graphs

F3 interpret and create pictographs and symbolic graphs

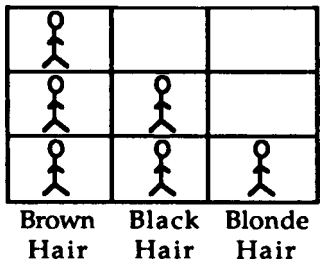
Bar graphs are one of the first ways to group and present data and are especially useful in grades K to 3. At this early level, bar graphs should be made so that each bar is made of countable parts such as squares, objects, or pictures of objects. No numeric scale is necessary. (Elementary School Mathematics,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

Elaboration - Instructional Strategies/Suggestions

F2 Students can create concrete and picture graphs, using objects such as candies, books or even themselves. It is essential that experiences are provided to ensure student understanding of the importance of

- a common base line
- one-to-one matching of objects in the various categories

❒ Use a piece of vinyl and masking tape to create a floor mat on which children can stand to form a graph.



❒ Have the children "vote" for favourite items or activities (e.g., favourite books or team logos) by placing the items (or pictures of them) on a graph under the appropriate headings.

F3 Pictographs are picture graphs that make use of stylized drawings instead of pictures. At this early stage, pictographs should be based on a one-to-one correspondence (i.e., a picture represents one item, not a group of items). Students should begin creating symbolic bar graphs, using pre-made squares of equal size. Later students can colour in a grid. Students should interpret and create both symbolic graphs that run horizontally and those that run vertically.

Graphs should be created primarily in the context of other investigations, rather than as an isolated activity to achieve the curriculum outcome.

❒ Suggest that students create a graph that shows the most popular authors of class members.

❒ Invite students to create and interpret a bar graph (using pre-cut pictures of birthday cakes) that shows birth months of class members. Natural connections to addition and subtraction can be made. Have students discuss what kinds of information they can get from reading the graph (Which months have the most/fewest birthdays? How can we use the graph to determine the number of children in our class? etc.).

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 the students to create a concrete graph to show the number of children in the class who play various games or musical instruments.

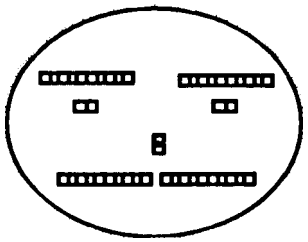
F2.2 Provide data as shown below. Also provide the corresponding colour of linking cubes.

blue eyes - 8
brown eyes - 12
green eyes - 4

Ask the student to use the cubes to make a graph to represent the information.

Paper and Pencil

F3.1 Ask the student to create a bar graph to show the number of rods and units in this picture of a face "worth 46."

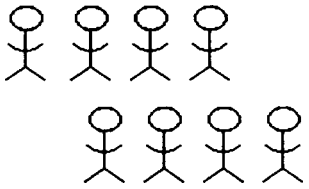


Interview

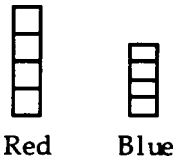
F3.2 Ask the student what is wrong with the conclusion drawn from the following graph. "As many kids like pizza as burgers."

F3.3 Present the model as shown at right:

The first line represents children with 1-piece snowsuits. The second line shows those with 2-piece snowsuits. Ask: Why is it difficult to tell which line has more children in it?



F3.4 Present a bar graph such as the one shown at right. Ask: What is wrong with this graph?



Presentation

F2.3 Invite small groups to demonstrate, using class members, why it is important for children to stand next to each other when deciding if more children are wearing red or blue.

Suggested Resources

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

iv) generate questions, develop and modify predictions and implement plans with respect to data analysis

SCO: By the end of grade 1, students will be expected to

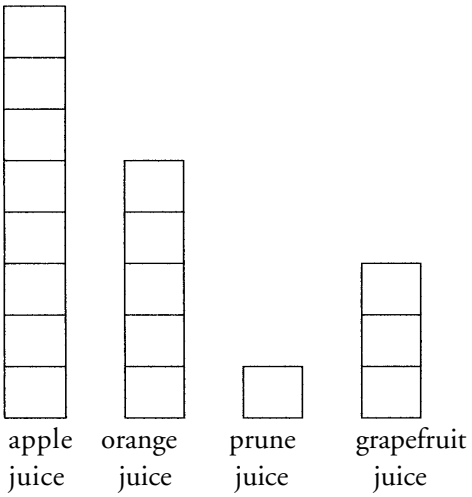
F4 pose oral questions in relation to conducting surveys and/or interpreting data

Elaboration - Instructional Strategies/Suggestions

F4 Students need to practise asking questions as well as answering them. Include questions to be used in conducting surveys as well as in interpreting results.

- ❒ Brainstorm with students to develop a list of investigation questions for possible surveys in a whole class situation. Record the student ideas on chart paper.
- ❒ Working with a bar graph that shows what class members had for breakfast supplies students with "answers" for which they have to guess the questions. Pairs of students may wish to provide answers and ask other students to supply the questions.

  Help students to see that there are many questions to be answered by looking at graphs.



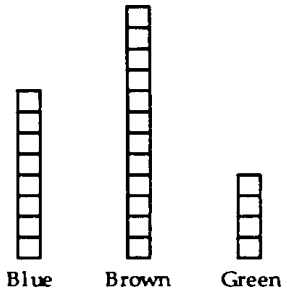
- How many like apple juice?
- How many more like apple juice than prune juice?
- How many students answered the questions about their favourite juice?
- Order the juices from most popular to least popular.

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

Worthwhile Tasks for Instruction and/or Assessment

Interview

F4.1 Show a graph of eye colour of students in the class.



Ask why the data might be interesting to know.

F4.2 Show students a graph indicating how many students in the class have cats, dogs, birds, and other pets. If, for example, there were 6 more children with cats than birds, say, "I looked at the graph and thought of a question it answers. The answer is 6. What was my question?"

F4.3 Ask students to pose questions about food packages for which they might investigate and collect data. Have them discuss how they would collect the information.

Presentation

F4.4 Have a group of students generate some questions that they might ask to find out more about animals.

Suggested Resources

ONE-PROBABILITY

Data Management and Probability

General Curriculum Outcome G:

Students will represent and solve problems involving uncertainty.

GCO G: Students will represent and solve problems involving uncertainty.

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

i) conduct informal investigations of chance and estimate probabilities with respect to games and other simple, everyday situations

SCO: By the end of grade 1, students will be expected to

G1 predict whether an event can never occur, must always occur, or simply might occur sometimes

Elaboration - Instructional Strategies/Suggestions

G1 Simple everyday situations can be used as contexts for predictions. Students should be asked whether events will always, sometimes, or never occur. Some examples follow:

- Bags of Coloured Cubes

  Have students watch as you place 10 red cubes in an empty bag. You pick a cube. Ask: Will it be red always? sometimes? never? Will it be green always? sometimes? never?

  Five red cubes and 5 blue cubes are placed in the bag. You pick a cube. Ask: Will it be red always? sometimes? never? Will it be yellow always? sometimes? never?

- Spinners

  A totally red spinner is spun. Ask: Will the pointer land on red always? sometimes? never?

  A spinner with a very small red section and a very large yellow section is spun. Ask: Will the pointer land on yellow always? sometimes? never?

- Classroom Events

  Ask: Does the bell ring at the end of the day always? sometimes? never? Is a teacher taller than his or her students always? sometimes? never? Are children in a class all the same age always? sometimes? never?

GCO G: Students will represent and solve problems involving uncertainty.

Worthwhile Tasks for Instruction and/or Assessment

Performance

G1.1 Provide an opaque bag and coloured cubes for the student. Ask the student to put 10 cubes in the bag so that red will never be chosen. Have the student repeat the task, this time putting in cubes so that red will always be chosen. Finally, the student repeats the task so that red will sometimes be chosen.

G1.2 Have the student create a design for a spinner so that the pointer will never land on green.

Interview

G1.3 Ask the student to describe an event that will never happen in the classroom.

G1.4 Ask the student to describe 3 events that will always happen.

G1.5 Ask the student to describe an event that happens sometimes, but not a lot.

Suggested Resources

ONE-INDEX

Index