MATHEMATICS K TO 7

Integrated Resource Package 1995

BRITISH COLUMBIA
Ministry of Education,
Skills and Training

IRP 003

Reprinted August 1996

PREFACE: USING THIS INTEGRATED RESOURCE PACKAGE

INTRODUCTION TO MATHEMATICS K TO 7

THE MATHEMATICS K TO 7 CURRICULUM

MATHEMATICS K TO 7 APPENDICES

This Integrated Resource Package (IRP) provides basic information teachers will require in order to implement the Mathematics K to 7 curriculum. The information contained in this IRP is also available via the Ministry web site: http://www.bced.gov.bc.ca/irp/irp.htm . The following paragraphs provide brief descriptions about each section of the IRP.

THE INTRODUCTION

The Introduction provides general information about Mathematics K to 7, including special features and requirements. It also provides a rationale for teaching Mathematics K to 7 in BC schools.

MATHEMATICS K TO 7 CURRICULUM

The provincially prescribed curriculum for Mathematics K to 7 is structured in terms of *curriculum organizers*. The main body of this IRP consists of four columns of information for each organizer. These columns describe:

- provincially prescribed learning outcome statements
- suggested instructional strategies for achieving the outcomes
- suggested assessment strategies for determining how well students are achieving the outcomes
- provincially recommended learning resources

Prescribed Learning Outcomes

Learning outcome statements are content standards for the provincial education system. Prescribed learning outcomes set out the knowledge, enduring ideas, issues, concepts, skills, and attitudes for each subject. They are statements of what students are expected to know and be able to do in each grade. Learning outcomes are clearly stated and expressed in observable terms. All learning outcomes complete the stem: "It is expected that students will. . . . ". Outcome statements have been written to enable teachers to use their experience and professional judgment when planning and evaluating. The outcomes are benchmarks that will permit the use of criterion-referenced performance standards. It is expected that actual student performance will vary. Evaluation, reporting, and student placement with respect to these outcomes depend on the professional judgment of teachers, guided by provincial policy.

Suggested Instructional Strategies

Instruction involves the use of techniques, activities, and methods that can be employed to meet diverse student needs and to deliver the prescribed curriculum. Teachers are free to adapt the suggested instructional strategies or substitute others that will enable their students to achieve the prescribed learning outcomes. These strategies have been developed by specialist and generalist teachers to assist their colleagues; they are suggestions only.

Suggested Assessment Strategies

The assessment strategies suggest a variety of ways to gather information about student performance. Some assessment strategies relate to specific activities; others are general. These strategies have been developed by specialist and generalist teachers to assist their colleagues; they are suggestions only.

Provincially Recommended Learning Resources

Provincially recommended learning resources are materials that have been reviewed and evaluated by BC educators in collaboration with the Ministry of Education according to a stringent set of criteria. These resources are organized as Grade Collections. A Grade Collection is the format used to organize the provincially recommended learning resources by grade and by curriculum organizer. It can be regarded as a 'starter set' of basic resources to deliver the curriculum. These resources are typically materials suitable for student use, but they may also include information primarily intended for teachers. Teachers and school districts are encouraged to select those resources that they find most relevant and useful for their students, and to supplement these with locally approved materials and resources to meet specific local needs.

The recommended resources listed in the main body (fourth column) of this IRP are those that either present comprehensive coverage of the learning outcomes of the particular curriculum organizer or provide unique support to specific topics. Further information about these recommended learning resources is found in Appendix B.

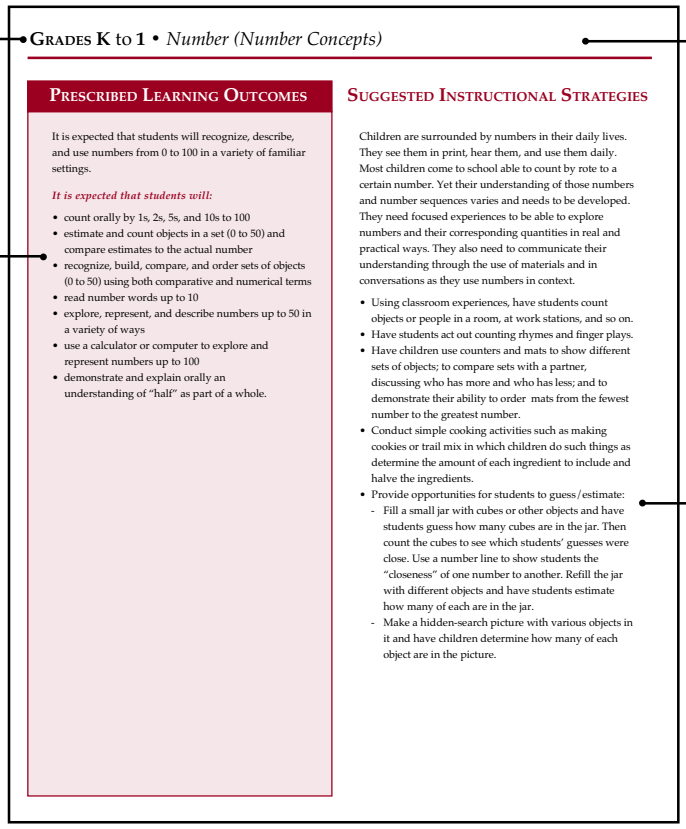
THE APPENDICES

A series of appendices provides additional information about the curriculum, and further support for the teacher.

- ***Appendix A*** lists the curriculum organizers and the prescribed learning outcomes for each grade for the curriculum.
- ***Appendix B*** consists of general information on learning resources as well as Grade Collection organizational charts and annotations for the provincially recommended resources. New resources are evaluated and added to the Grade Collections on a regular basis.
- ***Appendix C*** contains assistance for teachers regarding provincial evaluation and reporting policy. Prescribed learning outcomes have been used as the source for samples of criterion-referenced evaluations.
- ***Appendix D*** acknowledges the many people and organizations that have been involved in the development of this IRP.

Grade

Curriculum Organizer and Sub-Organizer



Prescribed Learning Outcomes

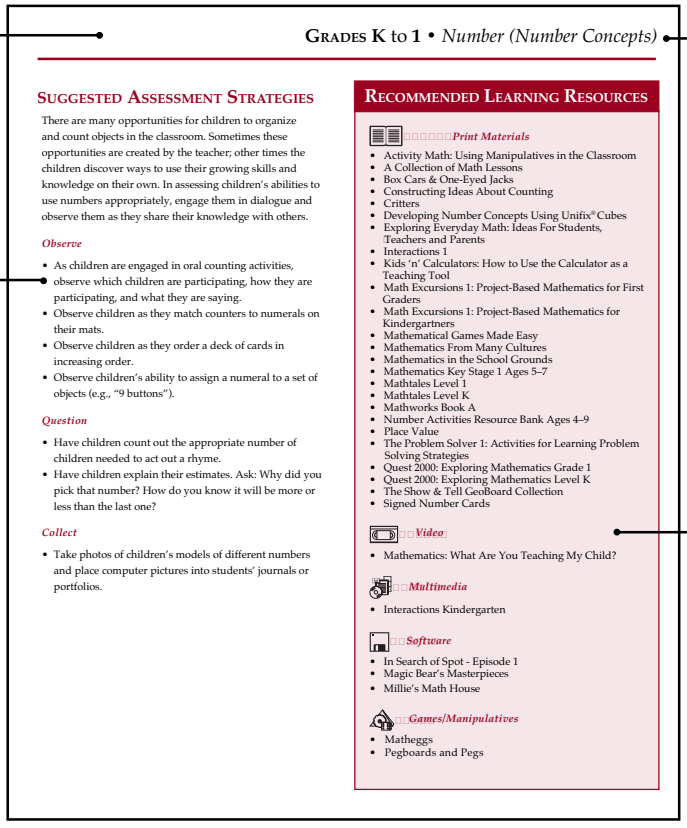
The Prescribed Learning Outcomes column of this IRP lists the specific learning outcomes for each curriculum organizer or sub-organizer. These aid the teacher in day-to-day planning.

Suggested Instructional Strategies

The Suggested Instructional Strategies column of this IRP suggests a variety of instructional approaches that include group work, problem solving, and the use of technology. Teachers should consider these as examples that they might modify to suit the developmental levels of their students.

Grade

Curriculum Organizer and Sub-Organizer



Suggested Assessment Strategies

The Suggested Assessment Strategies offer a wide range of different assessment approaches useful in evaluating the prescribed learning outcomes. Teachers should consider these as examples they might modify to suit their own needs and the instructional goals.

Recommended Learning Resources

The Recommended Learning Resources component of this IRP is a compilation of provincially recommended resources that support the prescribed learning outcomes. A complete list including a short description of the resource, its media type, and distributor is included in Appendix B of this IRP.

Principles of Learning

Instructional strategies in mathematics should be guided by the principles of learning. These are:

- learning requires the active participation of the student
- people learn in a variety of ways and at different rates
- learning is both an individual and a group process

Introduction to this Integrated Resource Package

The Primary Years

This Integrated Resource Package contains curriculum outcomes and support materials that apply to learners in the Primary Years (K to 3). The K to 3 curriculum outcomes in this document comprise the prescribed curriculum. The remaining components are intended to update or supplement many of the related support materials currently contained in the *Primary Program Foundation Document* and the *Primary Program Resource Document*.

Once all curriculum outcomes pertaining to the Primary Years have been updated or revised, the *Primary Program Foundation Document* and the *Primary Program Resource Document* will be revised and combined with the updated curriculum to comprise a Primary Years IRP. Until such time as the Primary Years IRP has been completed, teachers are encouraged to implement the new K to 7 curriculum and continue to use the remaining portions of the *Primary Program Foundation Document* and the *Primary Program Resource Document*.

The Mathematics K to 7 IRP includes prescribed learning outcomes, examples of instruction and assessment strategies, and recommended learning resources. It has been designed to help teachers deliver the prescribed curriculum in a way that meets the requirements of the K to 12 Education Plan. In its organization, this IRP links the learning outcomes with the instruction, assessment, and learning resources.

A variety of resources were used in the development of this IRP:

- The learning outcomes and strategies were developed with reference to the recommendations included in the *1990 Provincial Assessment of Mathematics.*
- Written resources included: *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics); *Guidelines for Student Reporting*; *The Common Curriculum Framework for K to 12 Mathematics (Western Canadian Protocol for Collaboration in Basic Education)*; and the provincial reference sets *Evaluating Problem Solving Across Curriculum*; *Evaluating Mathematical Development Across Curriculum;* and the *Assessment Handbook Series.*

This IRP represents the ongoing effort of the province to provide education programs that put importance on high standards in education while providing equity and access for all learners. It will be available in electronic format in addition to this print version.

Rationale

Mathematics is increasingly important in our technological society. To succeed in the workplace, students require the ability to reason and communicate, to solve problems, and to understand and use probability and statistics, technology, and measurement. Skills in these areas are also required of all mathematically literate citizens.

Becoming mathematically literate involves developing the ability to explore, to conjecture, to reason logically, and to use a variety of mathematical methods to solve problems. It involves the development of self-confidence and the ability to use quantitative and spatial information to solve problems and make decisions. As they develop mathematical literacy, students generally experience a growth in motivation and self-confidence in mathematics. This growth occurs when they learn to value the importance of mathematics, to develop mathematical habits of mind, and to understand and appreciate the role of mathematics in everyday life.

The provincial mathematics curriculum emphasizes the practical applications of learning and the types of skills needed in the knowledge-based workplace. The new curriculum places greater emphasis on probability and statistics, reasoning and communication, measurement, and problem solving. To ensure that students are prepared for the demands of both further education and the workplace, the early years of the mathematics curriculum (K to 7) must help students develop mathematical literacy.

Developing Positive Attitudes

Research, including provincial assessments, always emphasizes the direct association between students' attitudes and their levels of performance. Mathematics activities should engage the interest and imagination of all students so that they are willing to take risks, grow in their tolerance of ambiguity, and achieve high levels of development in their mathematical thinking. Classroom practice and teaching strategies should promote positive attitudes towards mathematics for *all* students, including those typically underrepresented in careers in mathematics.

Becoming Mathematical Problem Solvers

Problem solving is the cornerstone of mathematics instruction. Students must learn the skills of effective problem solving, including the ability to communicate solutions, so that they will become reasoning, thinking individuals able to contribute to society.

As students move through the grades, the curriculum presents them with increasingly diverse and complex mathematical problems to solve. Problem solving requiring mathematical thinking should evolve naturally out of day-to-day activities in the classroom and be an integral part of all mathematical activity, so that students will be able to explore, create, adjust to changes, and actively acquire new knowledge throughout their lives.

Communicating Mathematically

Mathematics is a language, a way of communicating ideas. Communication plays an important role in helping students build links between their informal, intuitive notions and the abstract language and symbolism of mathematics. Communication also plays a key role in helping students make important connections among physical, pictorial, graphic, symbolic, verbal, and mental representations of mathematical ideas. All activities that involve students in exploring, investigating, describing, justifying decisions, and explaining promote the development of communication skills. The K to 12 mathematics curriculum emphasizes discussing, writing, and representing mathematical thinking in various ways.

Connecting and Applying Mathematical Ideas

Learning activities should help students understand that mathematics is a changing and evolving domain, to which many cultural groups have contributed. Students become aware of the usefulness of mathematics when mathematical ideas are connected to everyday experiences. Learning activities should help students to relate mathematical concepts to real-world situations and allow them to see how one mathematical idea can help them understand others. This approach emphasizes the usefulness of mathematics in solving problems, describing and modelling real-world phenomena, and communicating complex thoughts and information in a concise and precise manner.

Reasoning Mathematically

Mathematics instruction should help students develop confidence in their ability to reason and to justify their thinking. Students should understand that mathematics is not simply memorizing rules. Mathematics should make sense, be logical, and be enjoyable.

Students' reasoning and logic abilities usually develop on a continuum from concrete to formal to abstract. Students use inductive reasoning when they make conjectures by generalizing from a pattern of observations; they use deductive reasoning when they test those conjectures. Students require the freedom to explore, conjecture, validate, and convince others if they are to develop mathematical reasoning skills. And it is important that their ability to reason well is valued as much as their ability to find correct answers.

Using Technology

New technology has changed the kind of mathematical problems encountered today, as well as the methods that mathematicians use to investigate them. Computers and calculators are powerful problem-solving tools. The power to compute rapidly and to graph mathematical relationships instantly will help students become mathematically self-sufficient. When they are able to use technology, students' growing curiosity can lead to rich mathematical invention.

Calculators and computers are tools that simplify, but do not accomplish, the work at hand, and the availability of calculators does not eliminate the need for students to learn basic facts and algorithms. Students must be

able to select and use the most appropriate tool or method for a calculation. The K to 12 mathematics curriculum puts increased emphasis on the use of available resources, including technology and the mass media.

Estimation and Mental Math

Mathematics involves more than exactness. Estimation skills enhance students' abilities to deal with everyday quantitative situations, and help them gain confidence and become more able to determine if something is mathematically correct. Students need to use reasoning, judgment, and decision-making skills when estimating. Instruction should emphasize an understanding of the value of estimation. It is also important that students develop the ability to mentally calculate simple arithmetic operations when precise answers are required.

Introduction to Mathematics K to 7

Organization of Learning Outcomes

The learning outcomes are arranged according to four curriculum organizers:

- Number
- Patterns and Relations
- Shape and Space
- Statistics and Probability

These curriculum organizers are the formal aspects of the discipline of mathematics. They form the framework of the curriculum and act as connecting threads across all grade levels. Within each curriculum organizer are two or three sub-organizers.

General Learning Outcomes by Organizer and Sub-Organizer

Organizer (Sub-Organizer)	General Learning Outcomes *It is expected that students will:*
Number (Number Concepts)	▶ use numbers to describe quantities ▶ represent numbers in multiple ways
(Number Operations)	▶ develop understanding of and proficiency with calculations ▶ describe what arithmetical operation or operations can be used to solve a problem and then solve the problem
Patterns and Relations (Patterns)	▶ use patterns to describe the world around them and to solve problems
(Variables and Equations)	▶ represent algebraic expressions in multiple ways
(Relations and Functions)	▶ use algebraic and graphical models to generalize patterns, make predictions, and solve problems
Shape and Space (Measurement)	▶ describe and compare real-world phenomena using either direct or indirect measurement
(3-D Objects and 2-D Shapes)	▶ describe the characteristics of 3-D objects and 2-D shapes and analyse the relationships among them
(Transformations)	▶ perform, analyse, and create transformations
Statistics and Probability (Data Analysis)	▶ collect, display, and analyse data to make predictions about a population
(Chance and Uncertainty)	▶ use experimental and theoretical probability to represent and solve problems involving uncertainty

Suggested Instructional Strategies

Teachers determine the best teaching methods for students, the best way of grouping students for particular studies, and the best way to present material to make it relevant and interesting. The instructional activities suggested in this resource include techniques, ideas, and methods that illustrate a variety of approaches to the prescribed curriculum for a diverse population of students.

Context Statements

Each set of instructional strategies starts with a context statement followed by several examples of learning activities. The context statement links the learning outcomes with instruction. It states why these outcomes are important for the mathematical development of the student, explains how children learn at this age, or suggests some ways to teach this part of the curriculum. The instructional activities are specific and relevant to one or more of the learning outcomes. Sometimes links are made to other subjects.

Instructional Activities

The new mathematics curriculum is designed to put more emphasis on the types of skills needed in the knowledge-based workplace, including those involving the use of probability and statistics, reasoning, communicating, measuring, and problem solving.

Additional emphasis is given to strategies and activities that:

- *foster the development of positive attitudes.* Students should be exposed to experiences that encourage them to enjoy and value mathematics, develop mathematical habits of mind, and understand and appreciate the role of mathematics in human affairs. They should be encouraged to explore, take risks, exhibit curiosity, and even to make and correct errors so that they gain confidence in their ability to solve complex problems. The assessment of attitudes is indirect and is based on inferences drawn from students' behaviour. We can see what students do, hear what they say, and from these observations, make inferences and draw conclusions about their attitudes.
- *apply mathematics.* For students to view mathematics as relevant and useful, they must see how it can be applied to a wide variety of real-world applications. Mathematics helps students to understand and interpret their world and to solve problems that occur in their daily lives.
- *use manipulatives.* The use of manipulatives is a good way to actively involve students in mathematics throughout the primary and intermediate grades. Manipulatives encourage students to explore, develop, estimate, test, and apply mathematical ideas in relation to the physical world. Manipulatives range from commercially developed materials to simple collections of materials such as boxes, cans, or cards. They can be used to introduce new concepts or provide a visual model of a mathematical concept.
- *use technology.* The use of technology in our society is increasing. Technological skills are becoming mandatory in the workplace. Instruction that uses a range of technologies such as calculators, computers, CD-ROMs, and videos will help students relate mathematics to their personal lives and prepare them for the future.
- *require problem solving.* For students to develop decision-making and problem-solving skills, they need learning

experiences that challenge them to recognize problems and actively try to solve them, to develop and use various strategies, and to learn to represent solutions in ways appropriate to their purposes. Problems that occur within the students' environment can be used as the vehicle or context for students to achieve the learning outcomes in any of the curriculum organizers.

Gender Issues in Mathematics

The education system is committed to helping both male and female students succeed equally well in the school system. This is particularly important in mathematics, where there is a need to dispel the perception that female students are likely to have difficulty with mathematics. Skill in mathematics is essential to the workplace and to everyone's ability to participate fully in society. Teaching, assessment materials, learning activities, and classroom environments should place value on the experiences and contributions of both men and women and people of diverse cultures.

Research regarding gender and mathematics has raised a number of important issues that teachers should consider when teaching mathematics. These include the diversity of learning styles, gender bias in learning resources, and unintentional gender bias in teaching. The following instructional strategies are suggested to help the teacher deliver a gender-sensitive mathematics curriculum.

- Feature female mathematicians or women who make extensive use of mathematics in their careers as guest speakers or subjects of study in the classroom.
- Design instruction to acknowledge differences in experiences and interests between boys and girls.
- Demonstrate the relevance of mathematics to a variety of careers and to everyday life in ways that are apt to appeal to particular students in the class or school. Successful links include biology, environmental issues, and current topics in mass media.
- Explore not only the practical applications of mathematics but also the human elements, such as ways in which ideas have changed throughout history and the social and moral implications of mathematics.
- Explore ways of approaching mathematics that will appeal to a wide variety of students. Comments received from female students suggest that teachers use a variety of approaches, including, for example, memorization, logic, speculation, exploration, or experimentation. Varying approaches appeal to a wider variety of students.
- Provide learning opportunities that are designed specifically for girls to help them develop confidence and an interest in mathematics.
- Emphasize that mathematics is used by ordinary people with a variety of interests and responsibilities.
- Provide opportunities for visual and hands-on activities, which most students enjoy. Experiments, demonstrations, field trips, and exercises that provide opportunities to explore the relevance of mathematics are particularly important for girls.

Adapting Instruction for Diverse Student Needs

When students with special needs are expected to achieve or surpass the learning outcomes set out in the mathematics curriculum, regular grading practices and reporting procedures are followed. However, when students are not expected to achieve the learning outcomes, adaptations and modifications must be noted in their Individual Education Plans (IEPs). Instructional and assessment methods should be adapted to meet the needs of all students.

The following strategies may help students with special needs succeed in mathematics:

- Adapt the Environment
  - Change the student's seat in the classroom.
  - Make use of co-operative grouping.
- Adapt Presentations
  - Provide students with advance organizers of the key mathematical concepts.
  - Demonstrate or model new concepts.
  - Adapt the pace of activities as required.
- Adapt Materials
  - Use techniques, such as colour-coding the steps to solving a problem, to make the organization of activities more explicit.
  - Use manipulatives such as large-size dice, cards, and dominoes.
  - Use large-print charts such as a 100s chart or a times-table chart.
  - Provide students with a talking calculator or a calculator with a large keypad.
  - Use large print on activity sheets.
  - Use opaque overlays on text pages to reduce the quantity of print that is visible.
  - Highlight key points on activity sheets.
- Adapt Methods of Assistance
  - Have peers or volunteers assist students with special needs.
  - Have students with special needs help younger students learn mathematics.
  - Have teacher assistants work with individuals and small groups of special needs students.
  - Work with consultants and support teachers to develop problem-solving activities and strategies for mathematics instruction for students with special needs.
- Adapt Methods of Assessment
  - Allow students to demonstrate their understanding of mathematical concepts in a variety of ways, such as through murals, displays, models, puzzles, game boards, mobiles, and tape recordings.
  - Modify assessment tools to match student needs. For example, oral tests, open-book tests, and tests with no time limit may allow students to better demonstrate their learning than a traditional timed paper-and-pencil test.
  - Set achievable goals.
  - Use computer programs that provide opportunities for students to practise mathematics as well as record and track their results.
- Provide Opportunities for Extension and Practice
  - At a given time require the completion of only a small amount of work.
  - Simplify the way questions are worded to match the student's level of understanding.
  - Provide functional, everyday contexts (e.g., cooking) in which students can practise measurement skills.

Suggested Assessment Strategies

Teachers determine the best assessment methods for their students. The assessment strategies sections in this document describe a variety of ideas and methods for gathering evidence of student performance. Each subsection begins with a context statement, which explains how students at this age can demonstrate their learning, what teachers can look for, and how this information can be used to adapt further instruction.

Following the context statements are more specific examples of assessment strategies. Some strategies relate to particular activities, while others are general and could apply to any activity. In some cases a format or further description of an assessment strategy is provided in "Managing Assessment Information," at the end of Appendix D.

Assessment

Assessment is the systematic process of gathering information about students' learning in order to describe what they know, are able to do, and are working towards. From the evidence and information collected in assessments, teachers describe each student's learning and performance. They use this information to provide students with ongoing feedback, plan further instructional and learning activities, set subsequent learning goals, and determine areas requiring diagnostic teaching and intervention. Teachers base their evaluation of a student's performance on the information collected through assessment. They use their insight, knowledge about learning, and experience with students, along with the specific criteria they establish, to make judgments about student performance.

Teachers determine the purpose, aspects, or attributes of learning on which to focus the assessment, when to collect the evidence, and the assessment methods, tools, or techniques most appropriate to use. Assessment focuses on the critical or significant aspects of the learning to be demonstrated by the student. Students benefit when they clearly understand the learning goals and the learning expectations.

The assessment of student performance is based on a wide variety of methods and tools including observation, student self-assessments, daily practice assignments, quizzes, samples of student work, pencil-and-paper tests, holistic rating scales, projects, oral and written reports, performance reviews, and portfolio assessments. A variety of assessment methods helps teachers compile a comprehensive profile of student learning.

Provincial Reference Sets

The provincial reference sets are an additional resource to help teachers assess the skills that students acquire across curricular areas. These include:

- *Evaluating Reading Across Curriculum* (RB0034)
- *Evaluating Writing Across Curriculum* (RB0020 and RB0021)
- *Evaluating Problem Solving Across Curriculum*
- *Evaluating Group Communication Skills Across Curriculum*
- *Evaluating Mathematical Development Across Curriculum*

The reference sets can help teachers focus assessment, establish assessment criteria, and provide a more complete picture of each student's development. In assessing student performance in mathematics, teachers may find the reference sets on problem solving, mathematical development, and group communication skills most applicable.

Provincial Learning Assessment Program

The provincial learning assessment program gathers information on students' performance throughout the province, is used in the development and revision of curriculum, and provides information about teaching and learning in B.C. The recommendations and conclusions of the 1990 Mathematics Assessment have contributed to the development of this IRP.

Learning Resources

Provincially recommended learning resources are defined as information, represented or stored in a variety of media and formats, that assists student learning as defined by provincial or local curricula. This includes, but is not limited to, materials in print, video, and software formats, as well as combinations of these formats intended for use by teachers and students.

Provincial Learning Resource Evaluations

The ministry promotes the establishment of a resource-rich learning environment through the evaluation of a wide variety of educationally appropriate materials to meet the needs of all learners. Resources are identified to support provincial curricula through an evaluation process carried out using practising teachers as evaluators. It is expected that teachers will select resources from those that meet the provincial criteria and that suit their particular pedagogical needs and audiences.

The use of learning resources involves the teacher as facilitator of learning. However, students may be expected to have some choice in materials for specific purposes such as independent reading or research. It is expected that a variety of resources will be utilized to support learning outcomes at any particular level. A multimedia approach integrating materials and media is encouraged.

Some selected resources have been identified to support cross-curricular integration. The ministry also considers special needs audiences in the evaluation and annotation of learning resources. As well, special format versions of some selected resources (Braille and taped-book formats) are available.

Status of Learning Resources

Learning resources for use in British Columbia schools will fall into one of three categories:

- *Provincially Recommended Materials:* materials evaluated through the provincial evaluation process, approved through Minister's Order, and purchased using targeted learning resource funds. These resources are listed in the *Catalogue of Learning Resources.*
- *Provincially Authorized Materials:* materials selected prior to 1989 by curriculum committees and are purchased through the Credit Allocation Plan. These resources are listed in the *Catalogue of Learning Resources.*
- *Locally Evaluated Materials:* materials evaluated through local (district/school) evaluation processes and approved for use according to district policy.

All learning resources used in schools must either have *recommended* or *authorized* designation or be approved through district evaluation and approval policies.

Appendix B of this Integrated Resource Package (IRP) includes a list of relevant resource titles and an abbreviated description to clarify the main function of each resource. Resources are organized by curriculum organizer followed by grade. More detailed

descriptions of each resource are available in annotation sets regularly distributed by the Ministry of Education, Skills and Training.

These annotation sets are detailed descriptions of learning resources, including grade levels, lists of components, teaching comments, cautions, ordering information, and other details.

Resources often have application to more than one curricular or topic area. Obvious connections are identified in annotations, but teachers will make many more connections as they work with materials in the spirit of integration. The index in each annotation document will help teachers organize resources by topic and cateogory.

Local Resource Evaluation

As previously indicated, districts that choose to evaluate materials locally must have a district evaluation policy in accordance with section 182 (2) (e) of the *School Act* as outlined in Minister's Order #143. Users at the local level may select provincially *recommended* or *authorized* resources, or they may choose resources that are not on the ministry's list. There is also an option to develop materials at the local level to support provincial or locally developed curricula.

Overview

Problem Solving	Kindergarten to Grade 1	Grades 2 to 3	Grade 4
Students:			
Number			
Number Concepts *Students:* • use numbers to describe quantities • represent numbers in multiple ways	• Recognize, describe, and use numbers from 0 to 100 in a variety of familiar settings	• Develops number sense for whole numbers from 0 to 1000 and common fractions to tenths	• Demonstrate number sense for whole numbers from 0 to 10 000 and for proper fractions
Number Operations *Students:* • demonstrate an understanding of and proficiency with calculations • decide which arithmetic operation or operations can be used to solve a problem and then solve the problem	• Demonstrate and use a variety of methods to show the processes of addition and subtraction on one-digit whole numbers	• Use a variety of strategies to apply a basic operation (+, -, x, ÷) on whole numbers and use these operations in solving problems. Choose, use, and defend the appropriate calculation strategy or technology to solve problems	• Apply arithmetic operations on whole numbers and illustrate their use in solving problems. Demonstrate an understanding of the addition and subtraction of decimal fractions
Patterns and Relations			
Patterns *Students:* • use patterns to describe the world around them and solve problems	• Identify, create, and compare patterns that arise from their daily experiences	• Investigate, establish, and communicate rules for numerical and non-numerical patterns that arise from daily and mathematical experiences, and use these rules to make predictions	• Investigate, establish, and communicate rules for, and predictions from, numerical and non-numerical patterns
Variables and Equations *Students:* • represent algebraic expressions in multiple ways	• Learning outcomes for Patterns and Relations (Variables and Equations) commence in Grade 6	• Learning outcomes for Patterns and Relations (Variables and Equations) commence in Grade 6	• Learning outcomes for Patterns and Relations (Variables and Equations) commence in Grade 6
Relations and Functions *Students:* • use algebraic and graphical models to generalize patterns, make predictions, and solve problems	• Learning outcomes for Patterns and Relations (Relations and Functions) commence in Grade 10	• Learning outcomes for Patterns and Relations (Relations and Functions) commence in Grade 10	• Learning outcomes for Patterns and Relations (Relations and Functions) commence in Grade 10
Shape and Space			
Measurement *Students:* • describe and compare real-world phenomena using either direct or indirect measurement	• Estimate, measure, and compare measures using whole numbers and non-standard units of measure	• Measure, estimate, and compare, using whole numbers and non-standard and standard units ofmeasur e	• Estimate, measure, and compare quantities, using decimal numbers and standard units of measure
3-D Objects and 2-D Shapes *Students:* • describe the characteristics of 3-D objects and 2-D shapes and analyse the relationships among them	• Explore, sort, and classify real-world and three-dimensional objects according to their properties	• Describe, classify, construct, and relate three-dimensional objects and two-dimensional shapes using common language to describe theirpr operties	• Describe, classify, construct, and relate three-dimensional objects and two-dimensional shapes, using mathematical vocabulary to describetheir pr operties
Transformations *Students:* • perform, analyse, and create transformations	• Describe verbally the relative position of both three-dimensional objects and two-dimensional shapes	• Use positional language, numbers, and directional wordsto describe the relative positions of objects in onedimension and to comm unicate motion in real-worldcontexts	• Use numbers and directional words to describe the relative positions of objects in two dimensions, using real-world contexts
Statistics and Probability			
Data Analysis *Students:* • collect, display, and analyse data to make predictions about a population	• Collect, organize, and analyse (with assistance) data based on first-hand information	• Collect data based on first- and second- hand information, display results in more than one way, interpret data, and make predictions	• Collect first- and second-hand data, assess and validate the data collection process, and graph the data
Chance and Uncertainty *Students:* • use experimental or theoretical probability to represent and solve problems involving uncertainty	• Describe concepts of chance and chance events using ordinary vocabulary	• Use simple experiments designed by others to illustrate and explain probability and chance	• Conduct simple probability experiments to explainoutcomes

Grade 5	Grade 6	Grade 7	Grade 8
			• Use a variety of methods to solve all forms of problems (e.g., real-life, practical, technical, theoretical)
• Demonstrate number sense for whole numbers, from 0 to 100 000, and explore proper fractions and decimalfractions	• Develop number sense for common fractions and explore number sense for whole numbers	• Demonstrate number sense for decimal fractions and integers (including whole numbers)	• Demonstrate number sense about rational numbers, including common fractions, integers, and whole numbers
• Apply arithmetic operations on whole numbers and decimal fractions and illustrate the use of decimal fractionsin solvingpr oblems	• Apply arithmetic operations on whole numbers and decimal fractions in solving problems	• Apply arithmetic operations on decimal fractions and integers and illustrate their use in solving problems. Illustrate the use of ratios, rates, percentages, and decimal numbers in solving problems	• Apply the four basic arithmetic operations to rational numbers to solve real-world problems • Apply the concepts of ratio, rate, percentage, and proportion to solve problems in practical contexts
• Construct, extend, and summarize patterns, using rules, charts, mental mathematics, and calculators	• Use relationships to summarize, generalize, and extendpatterns	• Express patterns in terms of variables and use expressions containing variables to make predictions	• Create and use patterns, variables, expressions, equations, and graphs to solve problems
• Learning outcomes for Patterns and Relations (Variables and Equations) commence in Grade 6	• Use informal and concrete representations of equality and operations on equality to solve problems	• Use variables and equations to express, summarize, and apply relationships as problem-solving tools in a restricted range of contexts	• Solve and verify one-step and two-step linear equations that have rational number solutions
• Learning outcomes for Patterns and Relations (Relations and Functions) commence in Grade 10	• Learning outcomes for Patterns and Relations (Relations and Functions) commence in Grade 10	• Learning outcomes for Patterns and Relations (Relations and Functions) commence in Grade 10	• Learning outcomes for Patterns and Relations (Relations and Functions) commence in Grade 10
• Use measurement concepts, appropriate tools, and the results of measurements to solve problems in real-lifecontexts	• Solve problems involving perimeter, area, surface area, volume, and angle measurement	• Solve problems involving the properties of circles and their relationships to angles and time zones	• Apply the Pythagorean relationship to solve direct and indirect measurement problems • Discover patterns in measurement, and generalize procedures to solve problems involving area, perimeter, volume, and surface area
• Use the visualization of two-dimensional shapes and three-dimensional objects to solve problems related to spatial relation	• Use visualization and symmetry to solve problems involving classification and sketching	• Link angle measurements to the properties of parallel lines	• Link angle measures and the properties of parallel lines to the classification and properties of quadrilaterals
• Describe motion in terms of a slide, a turn, or a flip	• Create patterns and designs that incorporate symmetry, translations, tessellations, and reflections	• Create and analyse patterns and designs using congruence, symmetry, translation, rotation, andr eflection	• Create and analyse design problems and architectural designs using the properties of scaling, proportion, and networks
• Develop and implement a plan for the collection, display, and analysis of data gathered from appropriatesamples	• Develop and implement a plan for the collection, display, and analysis of data gathered from appropriate samples	• Develop and implement a plan for the collection, display, and analysis of data using measures of variability and central tendency	• Develop and implement a plan for the collection, display, and analysis of the data, using technology as required • Evaluate and use measures of central tendency and variability
• Predict outcomes, conduct experiments, and communicate the probability of single events	• Use numbers to communicate the probability of single events from experiments and models	• Create and solve problems using probability	• Compare theoretical and experimental probability of independent events.

Estimated Instructional Time

The *Kindergarten to Grade 12 Education Plan* (September 1994) outlines the required areas of study for the primary and intermediate years and, as appropriate, indicates the recommended time allotments for each area of learning. In the primary years, teachers are encouraged to combine various curricula to enable students to integrate ideas and see applications of knowledge. In grades 4 to 7 a minimum of 30% of the total time in school is recommended for the study of Science, Mathematics, and Technology. The following chart shows the estimated instructional time for each curriculum organizer, expressed as a percentage of total time available to teach the course.

Mathematics K to 7

Curriculum Organizer	% of Time
Number	40
Patterns and Relations	20
Shape and Space	25
Statistics and Probability	15

These estimated time allotments represent the amount of instructional time that has been recommended to meet the prescribed learning outcomes within each curriculum organizer. When delivering the prescribed curriculum, teachers may freely adjust the instructional time to meet their students' diverse needs. These estimated instructional times have been recommended to assist teachers; they are suggestions only.

Curriculum

Mathematics K to 7

PRESCRIBED LEARNING OUTCOMES

It is expected that students will recognize, describe, and use numbers from 0 to 100 in a variety of familiar settings.

It is expected that students will:

- count orally by 1s, 2s, 5s, and 10s to 100
- estimate and count objects in a set (0 to 50) and compare estimates to the actual number
- recognize, build, compare, and order sets of objects (0 to 50) using both comparative and numerical terms
- read number words up to 10
- explore, represent, and describe numbers up to 50 in a variety of ways
- use a calculator or computer to explore and represent numbers up to 100
- demonstrate and explain orally an understanding of "half" as part of a whole

SUGGESTED INSTRUCTIONAL STRATEGIES

Children are surrounded by numbers in their daily lives. They see them in print, hear them, and use them daily. Most children come to school able to count by rote to a certain number. Yet their understanding of those numbers and number sequences varies and needs to be developed. They need focused experiences to be able to explore numbers and their corresponding quantities in real and practical ways. They also need to communicate their understanding through the use of materials and in conversations as they use numbers in context.

- Using classroom experiences, have students count objects or people in a room, at work stations, and so on.
- Have students act out counting rhymes and finger plays.
- Have children use counters and mats to show different sets of objects; to compare sets with a partner, discussing who has more and who has less; and to demonstrate their ability to order mats from the fewest number to the greatest number.
- Conduct simple cooking activities such as making cookies or trail mix in which children do such things as determine the amount of each ingredient to include and halve the ingredients.
- Provide opportunities for students to guess/estimate:
  - Fill a small jar with cubes or other objects and have students guess how many cubes are in the jar. Then count the cubes to see which students' guesses were close. Use a number line to show students the "closeness" of one number to another. Refill the jar with different objects and have students estimate how many of each are in the jar.
  - Make a hidden-search picture with various objects in it and have children determine how many of each object are in the picture.

SUGGESTED ASSESSMENT STRATEGIES

There are many opportunities for children to organize and count objects in the classroom. Sometimes these opportunities are created by the teacher; other times the children discover ways to use their growing skills and knowledge on their own. In assessing children's abilities to use numbers appropriately, engage them in dialogue and observe them as they share their knowledge with others.

Observe

- As children are engaged in oral counting activities, observe which children are participating, how they are participating, and what they are saying.
- Observe children as they match counters to numerals on their mats.
- Observe children as they order a deck of cards in increasing order.
- Observe children's ability to assign a numeral to a set of objects (e.g., "9 buttons").

Question

- Have children count out the appropriate number of children needed to act out a rhyme.
- Have children explain their estimates. Ask: Why did you pick that number? How do you know it will be more or less than the last one?

Collect

- Take photos of children's models of different numbers and place computer pictures into students' journals or portfolios.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Activity Math: Using Manipulatives in the Classroom
- A Collection of Math Lessons
- Box Cars & One-Eyed Jacks
- Constructing Ideas About Counting
- Critters
- Developing Number Concepts Using Unifix® Cubes
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Interactions 1
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math Excursions 1: Project-Based Mathematics for First Graders
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Mathematical Games Made Easy
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mathtales Level 1
- Mathtales Level K
- Mathworks Book A
- Number Activities Resource Bank Ages 4–9
- Place Value
- The Problem Solver 1: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 1
- Quest 2000: Exploring Mathematics Level K
- The Show & Tell GeoBoard Collection
- Signed Number Cards

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions Kindergarten

Software

- In Search of Spot - Episode 1
- Magic Bear's Masterpieces
- Millie's Math House

Games/Manipulatives

- Matheggs
- Pegboards and Pegs

PRESCRIBED LEARNING OUTCOMES

It is expected that students will demonstrate and use a variety of methods to show the processes of addition and subtraction on one-digit whole numbers.

It is expected that students will:

- demonstrate and orally describe the process of addition and subtraction to 18 using role-play, manipulatives, and diagrams (memorization is not intended)

SUGGESTED INSTRUCTIONAL STRATEGIES

Children need to make sense of the different ways that numbers are used so that they can develop an understanding of the relationship both within a number and between numbers. They should develop computational skills by doing meaningful tasks each day, both in school and at home. Their conceptual understanding of addition and subtraction begins with concrete experiences arising from problem situations. These experiences provide them with the opportunity to understand the purpose for their computations, as well as the opportunity to develop their arithmetic skills of adding and subtracting.

- Have students act out different classroom situations:
  - Three people are going to the library, and two are going to use the computer lab. How many are going altogether?
  - There are six cookies on the plate. Johnny takes two. How many are left?
  - Five people chose 2% milk for lunch. Seven chose orange juice. How many more chose orange juice than milk?
- When dealing with calendar activities, have children count forward and back to specific days or events. Ask:
  - How many days until _____'s birthday?
  - How many days since we went skating?
- Have students roll a die (with numbers 4 to 9 on it) and place that number of counters on their work space. Have them roll the die again. Ask them whether they need to add or subtract counters to make the new number.
- Have children use two colour counters to "spill the beans" and then tell how the beans landed (e.g., four red and two yellow).

SUGGESTED ASSESSMENT STRATEGIES

Young children often have difficulty describing number operations in an abstract way, but are able to show how they did something. Thus, the results (products) of their work may be records of their activities rather than a demonstration of their understanding. If you observe children as they work towards an answer and talk to them about what they are doing, it will help you to determine the extent to which they are able to understand the processes of addition and subtraction.

Observe

- Observe how children solve the problems described under "Suggested Instructional Strategies." Ask them probing questions such as: How did you figure that out? Is there another way to solve the problem? Show me. Make up another problem like this.
- Present students with a task such as the following: If I have six counters and two are red, how many are yellow? Show me how you know.

Record

- Videotape the children's role-plays of different classroom situations and have them use manipulatives to illustrate what happened.
- Have children make pictorial records of their dice-rolling activities.

RECOMMENDED LEARNING RESOURCES

Print Materials

- A Collection of Math Lessons
- Box Cars & One-Eyed Jacks
- Constructing Ideas About Counting
- Critters
- Developing Number Concepts Using Unifix® Cubes
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Interactions 1
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math Excursions 1: Project-Based Mathematics for First Graders
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mathtales Level 1
- Mathtales Level K
- Number Activities Resource Bank Ages 4–9
- One Odd Old Owl
- The Problem Solver 1: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 1
- Quest 2000: Exploring Mathematics Level K
- Sense-Able Science

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions Kindergarten

Software

- In Search of Spot - Episode 1

Games/Manipulatives

- Abacus
- Matheggs
- Pegboards and Pegs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will identify, create, and compare patterns that arise from their daily experiences.

It is expected that students will:

- identify, reproduce, extend, create, and compare patterns using actions, manipulatives, diagrams, and spoken terms
- recognize patterns in the environment

SUGGESTED INSTRUCTIONAL STRATEGIES

When you point out and discuss patterns, children are able to see connections and relationships within mathematics more easily. If young children are to understand relations and functions, the study of patterns is essential. The ability to see patterns helps them become better problem-solvers and flexible thinkers. It is important for young children to link patterns to their environment and to the regular activities in the classroom. Their active engagement during pattern activities is essential to their development of understanding. For example, talking about patterns will help children deepen their understanding and appreciation of pattern.

- Using various common materials such as buttons, keys, and shells, create a pattern and ask children to copy and predict what will come next. Ask:
  - Why do you think that comes next?
  - Can you keep the pattern going?
  - How can you make the same pattern using Unifix cubes? Using other materials?
  - Make up some actions to do with your pattern (e.g., stand, sit, stand, sit).
  - What words can you use to describe your pattern? (e.g., day, night, day; or Spring, Summer, Fall, Winter; and so on.)
- Take the children for a walk around the school. Stop to discuss any patterns that children notice. When you return to the classroom, ask students to draw the pattern they liked the best. Have them make a model of the pattern using pattern blocks, Unifix cubes, and other materials.
- Have children bring things from home that contain a pattern. Ask them how they can make a record of their patterns (e.g., by drawing, stamping, cutting).
- Have a pattern day when everyone wears a pattern to school.
- Have children use a calculator with a constant key to create a counting pattern such as 2, 4, 6, 8. . . .

SUGGESTED ASSESSMENT STRATEGIES

Children demonstrate their attitudes, skills, and understanding when they have frequent opportunities to discover and create patterns. Most children are enthusiastic about sharing the patterns they find and create, and are easily encouraged to talk about the patterns they see both inside and outside of the classroom.

Observe

- Observe how easily the child reproduces a pattern. Is the pattern consistent?
- Observe the complexity of the child's patterns.
- Observe the kinds of attributes the child uses to describe a pattern.
- Note whether the child uses a variety of materials in making patterns.

Question

- When students are identifying and comparing patterns, ask:
  - How many different patterns can you see? What helped you find them? Which one did you see first?
  - Have you seen any other patterns like this? Where?
  - Where do you think you could find other patterns like this one?
  - What parts of these are the same? What parts are different?
- When they are creating patterns, ask:
  - How did you decide how to make that?
  - How is your pattern the same as (or different from) _____.
  - Have you ever made a pattern like this before? Where? Do you think you could make the same pattern using other objects? How would you make that pattern?

Collect

- Collect samples of students' work showing their pattern creations.
- Take photographs of children working with patterns.

RECOMMENDED LEARNING RESOURCES

Print Materials

- About Teaching Mathematics
- Activity Math: Using Manipulatives in the Classroom
- Be SMART: Sorting, Matching, Arranging, Recognizing, Thinking Skills
- Box Cars & One-Eyed Jacks
- A Collection of Math Lessons
- Constructing Ideas About Counting
- Developing Number Concepts Using Unifix® Cubes
- Gobble Up Math
- Interactions 1
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Making Patterns
- Math and Literature
- Math Excursions 1: Project-Based Mathematics for First Graders
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Mathematical Games Made Easy
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mathtales Level K
- Mathworks Book A
- The Problem Solver 1: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 1
- Quest 2000: Exploring Mathematics Level K
- The Show & Tell GeoBoard Collection

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions Kindergarten

Software

- Millie's Math House

Games/Manipulatives

- Abacus
- Matheggs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will estimate, measure, and compare measures using whole numbers and non-standard units of measure.

It is expected that students will:

- classify, describe, and arrange objects using comparative language to compare length, size, area, weight, and volume
- use comparative terms to describe time and temperature
- compare the relative sizes of non-standard units by measuring the same object using different units of measurement, and recognize that different objects may have the same mass
- select an appropriate non-standard unit to estimate, measure, record, compare, and order objects and containers
- estimate the number of uniform objects and irregular shapes that will cover a given area and verify their estimates by covering and counting
- compare and sequence events according to the duration of time (using non-standard units), time of day, days of the week, and the seasons

SUGGESTED INSTRUCTIONAL STRATEGIES

Children are explorers. One of the many ways they explore their world is by measuring — estimating the size of both real and imagined objects, comparing themselves to others, calculating how long it will be until an important day arrives. Instruction in measurement gives children practical applications for the other mathematical skills they are learning.

- Provide many opportunities for students to order a variety of objects (e.g., baseball, book, orange, stapler) according to size. Have them rearrange the objects in order by weight. Discuss how one might determine how much more one object weighed than another: How might numbers be used to describe this? Which measurement tools (rulers, thermometers, measuring cups, scales) can be used in a particular situation?
- Based on situations arising naturally in the classroom, refine and expand students' language to describe time and temperature. For example, a thermometer placed outside the window could be checked daily for temperature readings. The class discussion would include terms such as *colder*, *hotter*, and *warm*.
- Have students trace around one hand on a piece of paper and cut it out. Working with a partner, they can then estimate how many hands would cover different objects in the room and try it to find out the correct answer. Have students record the information using a grid. Repeat the activity using other, non-standard units.
- Read a story that develops the concept of sequencing events in time. Discuss the pattern with the children. Students can then create their own stories based on personal experiences.

SUGGESTED ASSESSMENT STRATEGIES

At first, young children find out about the size of particular objects by making direct comparisons. For example, they place objects on top of each other to see which is bigger or longer. Gradually, with ample first-hand experience, they learn to estimate and compare what is being measured with a suitable standard unit of measure. As they work and talk about objects and events that are important to them, they offer insights into their thinking.

Observe

- Observe students during whole-class or partner activities when they are ordering objects according to size. Note the following: Can students explain their reasons for ordering objects in a given sequence (size, length, weight, and so on)? How do students select measurement tools for a given task?
- Have students look at a class weather chart to identify "the coldest day this week." Have them record the date and temperature, and describe that day with words or pictures on the classroom calendar or in their learning log. Note which students are able to compare numbers, which students make the connection between lower numbers and colder temperatures, and how students use comparative language in talking about weather.
- Observe students as they trace their hands and cut out shapes. How do they cover the area of the selected surface? (e.g., Does the spacing of their hands cover the whole area or only part of the area?)

Record

- Examine the record sheets that students complete as they compare, estimate, and measure size in various situations. Do their estimations improve over time? To what extent do different materials affect their estimates? (e.g., Can the container hold more rice or popcorn?)

RECOMMENDED LEARNING RESOURCES

Print Materials

- Activity Math: Using Manipulatives in the Classroom
- A Collection of Math Lessons
- Critters
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Gobble Up Math
- Interactions 1
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math and Literature
- Math Excursions 1: Project-Based Mathematics for First Graders
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mathtales Level K
- Mathtales Level 1
- Mathworks Book A
- Measure It! K-Grade 3
- Quest 2000: Exploring Mathematics Grade 1
- Quest 2000: Exploring Mathematics Level K

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions Kindergarten

Games/Manipulatives

- Abacus
- Pegboards and Pegs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- recognize and name the value of pennies, nickels, and dimes
- use money as a form of exchange
- create equivalent sets of coins up to 10¢ in value

SUGGESTED INSTRUCTIONAL STRATEGIES

- Give students collections of real coins. Have them work with partners to sort the coins by type. Students could add labels to the sorted piles: name of coin, colour, size, and image on coin. Have a class discussion about the activity, and then invite students to revise their records based on the class discussion.
- Have students build stacks of coins that meet given criteria:
  - stack equal to 10¢ (two nickels or one dime, or one nickel plus five pennies, or ten pennies)
  - stack containing three coins to equal a specific amount (e.g., 7¢)

  Students can record the stacks in a variety of ways, using illustrations, equations, and so on.
- Set up a store or restaurant. Conduct role-plays in which students exchange money for food or other products.

SUGGESTED ASSESSMENT STRATEGIES

Most children are easily engaged by mathematical activities and dramatic play in which they use money. When they are provided with coins or play money, they are likely to invent their own games or activities that allow them to practise and reveal the skills and knowledge they have developed.

Observe

- Listen to students' conversations during their dramatic play. Which students introduce money into their play activities? Do they speak accurately about different denominations of coins?

Question

- Questions such as the following can help to probe students' understanding:
  - How many ways could you make a stack worth 10¢?
  - Which of these coins is worth more? How do you know?

Collect

- Examine students' record sheets. How complete are their descriptions of each coin?

Reflect

- Which students are not yet able to sort and compare the value of coins? What additional experiences might help?
- Which students are confident and accurate in dealing with coins? What activities might help them make connections to other mathematical topics?
- You may wish to set up a diagnostic conference or a structured situation in which you can observe students who are inconsistent in working with coins. For example, you might role-play a store or restaurant transaction with students so that you can create situations in which they deal with different tasks or problems.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Activity Math: Using Manipulatives in the Classroom
- A Collection of Math Lessons
- Critters
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Gobble Up Math
- Interactions 1
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math and Literature
- Math Excursions 1: Project-Based Mathematics for First Graders
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mathtales Level K
- Mathtales Level 1
- Mathworks Book A
- Measure It! K-Grade 3
- Quest 2000: Exploring Mathematics Grade 1
- Quest 2000: Exploring Mathematics Level K

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions Kindergarten

Games/Manipulatives

- Abacus
- Pegboards and Pegs
- The Sum-Thing

Prescribed Learning Outcomes

It is expected that students will explore, sort, and classify real-world and three-dimensional objects according to their properties.

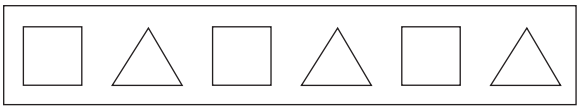
It is expected that students will:

- explore and describe real-world and three-dimensional objects using descriptive attributes such as *big*, *little*, *like a box*, and *like a can*
- explore, identify, and classify three-dimensional objects in the environment according to their properties
- construct three-dimensional objects using materials such as plasticine, blocks, and boxes
- identify and describe specific two-dimensional shapes such as circles, squares, triangles, or rectangles
- construct and rearrange a design using a set of two-dimensional shapes
- compare, sort, classify, and pattern two-dimensional shapes

Suggested Instructional Strategies

The world around us is filled with shapes. Young children experience the world through touch, sight, and movement. Early geometric activities should involve the exploration and investigation of shapes and their properties in the real world so that children are able to make sense of their experiences and arrive at some common understanding about these shapes and objects. It is also vital that children develop the language they need to convey their understanding.

- Have students collect objects (e.g., boxes, cans) from home or the classroom and then sort and re-sort them using a variety of attributes, such as size (big, little), colour, and shape (round, square).
- Have students make models of skyscrapers, using boxes, cans, wooden cubes, Lego, Polydrons, or other materials.
- Have children use attribute blocks, pattern blocks, or pictures from magazines to identify various two-dimensional shapes. They can then sort and classify the objects according to common attributes.
- Given a design or picture, have children use tangram pieces (or pattern-block pieces) to recreate the design. Ask them to try to use different pieces to make the same design or picture or to make a new design using the same pieces.
- Have students use a set of shapes to make a border pattern around a placemat.



SUGGESTED ASSESSMENT STRATEGIES

Children learn about shape and space by exploring and manipulating real objects. They demonstrate their emerging skills and knowledge by the approaches they use, the games they invent, and the structures and designs they create. Teachers notice and record children's actions, their conversations, the explanations they offer, and their ability to engage and persevere in tasks involving geometry.

Observe

- Observe and note the processes students use, their ability to explain or show their choices, their perseverance in doing the task, their attention to detail, and the extent to which they make appropriate or inappropriate choices.
- As students sort, note:
  - the number of ways they did the sort
  - the kinds of attributes they used
  - the way they described their sorts
  - their explanation of why these shapes fit together
- When students are asked to construct and rearrange a design, note the ease with which they are able to cover the design and rearrange the pieces. You might ask:
  - How did you approach the task?
  - Why did you do it that way?
  - Which pieces did you start with? Why?
- Ask students to describe their patterns. Note the complexity of the patterns, students'use of the names of shapes, and the variety of shapes they used.

Record

- Record your observations on an "at a glance" sheet or checklist.
- Children can record their designs by gluing similar paper pieces to paper. You can save these recordings to make books or to place in portfolios.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Activity Math: Using Manipulatives in the Classroom
- Circles and Spheres
- A Collection of Math Lessons
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Gobble Up Math
- Interactions 1
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math and Literature
- Math Excursions 1: Project-Based Mathematics for First Graders
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematics From Many Cultures
- Mathematics Key Stage 1 Ages 5–7
- Mathtales Level K
- Mathtales Level 1
- Mathworks Book A
- Measure It! K-Grade 3
- Quest 2000: Exploring Mathematics Grade 1
- Quest 2000: Exploring Mathematics Level K
- Sense-Able Science
- Squares and Cubes

Video

- Mathematics: What Are You Teaching My Child?
- The Private Eye

Multimedia

- Interactions Kindergarten

Software

- Magic Bear's Masterpieces
- Millie's Math House

Games/Manipulatives

- Pegboards and Pegs

PRESCRIBED LEARNING OUTCOMES

It is expected that students will describe verbally the relative position of both three-dimensional objects and two-dimensional shapes.

It is expected that students will:

- use directional terms such as *over*, *under*, *beside*, *near*, *far*, *left*, and *right* to describe the relative position of objects and shapes
- match the size and shape of figures by superimposing one on top of another
- identify and fit pieces of puzzles or shapes that go together (part to whole relationship)
- explore and describe reflection in mirrors

SUGGESTED INSTRUCTIONAL STRATEGIES

Young children's views of the world are directly related to themselves. They see things in relationship to who or where they are. Activities used to develop spatial sense must involve children in doing things physically, either by moving themselves in relation to something else, or by moving the objects around them. By engaging in these activities they learn the language needed to describe the movements. As their view of themselves and the world around them broadens, they can begin to use this language to place themselves and the objects into positions in space and to view these things from different perspectives.

- In everyday activities use directional terms that describe where things are found in the classroom or where people are to move.
- Read "Rosie's Walk" by Pat Hutchens to the children. Have them act out and explain where Rosie went. Set up an obstacle course in which children go *over*, *under*, *through*, and so on. Then have the children retell the story.
- Using pattern blocks, have children make a design and then redo the design in another way by placing new pattern blocks on top of the first design.
- Have children place Unifix cubes or rubber bands on a geoboard according to oral directions:
  - Put the yellow Unifix on the second nail.
  - Put a rubber band on top of the row of nails.
- Set out a variety of mirrors and pictures from magazines or books for children to explore with. Ask:
  - What happens when you move the mirror?
  - What happens if you use two (or three) mirrors?

SUGGESTED ASSESSMENT STRATEGIES

Most children enjoy demonstrating movements and talking about their actions and positions. They refine and offer insights into their understanding of shape and space through their actions and their explanations.

Observe

- Note your observations in the following areas:
  - Was the child able to do the task?
  - How easily did the child accomplish the task?
  - How does the child explain his/her movements?
  - What type of vocabulary is the child using?
  - To what degree does the child persevere with the task?
  - Does the child turn/rotate/flip pieces to make things fit?
  - Does the child use visual clues or tactile clues?

Question

- Ask:
  - How could I place my blocks to make a design the same as yours?
  - How did you know that those shapes (or puzzle pieces) would fit together?
  - Do you like putting puzzles together? What kinds of puzzles are easy for you? What kinds are hard? What do you do to figure out hard ones?

Record

- Videotape a child/class/group during activities to assess the ease with which the child/class/group follows directions.
- Note the amount of time children spend on a task, especially when putting puzzles together.
- Use focus sheets and checklists for recording observations.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Interactions 1
- Math and Literature
- Math Excursions 1: Project-Based Mathematics for First Graders
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Quest 2000: Exploring Mathematics Grade 1
- Quest 2000: Exploring Mathematics Level K
- The Show & Tell GeoBoard Collection

Video

- Mathematics: What Are You Teaching My Child?
- The Private Eye

Multimedia

- Interactions Kindergarten

Games/Manipulatives

- Architek (English Version)
- Matheggs
- Pegboards and Pegs

PRESCRIBED LEARNING OUTCOMES

It is expected that students will collect, organize, and analyse (with assistance) data based on first-hand information.

It is expected that students will:

- collect first-hand information by counting objects, conducting surveys, measuring, and performing simple experiments
- sort objects to one attribute chosen by themselves or the teacher
- construct a pictograph using one-to-one correspondence
- compare data using appropriate language, including quantitative terms
- pose oral questions in relation to the data gathered

SUGGESTED INSTRUCTIONAL STRATEGIES

Making sense of data begins with children's experiences in collecting, sorting, and classifying objects and information. By exploring interesting questions posed by the children, and collecting and displaying data that address those questions, we help them to organize their thinking and to make predictions about the information. Students' progress over time from concrete to pictorial representation of data is an important step towards their understanding of the abstract nature of statistics.

- Have children bring their favourite "bedtime buddy" (such as a stuffed animal) to school. As they examine each other's buddies, they can discuss the buddies' different attributes. For example:
  - Is there more than one type of buddy? One colour? One size?
  - How could we find out if there is more of one type than another?
  - Can the buddies be sorted according to teddies and other animals?
  - Does one group have more/less?
- Ask how the buddies can be sorted or classified:
  - How can the buddies be organized in a two-column real graph to show clearly how many more/fewer of each group there are?
  - What will happen if we graph our buddies by colour? By size?
- Have the children graph their buddies as suggested above as often as their interest permits. Have a class discussion about each graph.
- Have children draw their buddies on a square piece of paper and place the drawings on a chart column to make a pictorial representation (pictograph) of their real graph. Discuss the graphs.
- Using Unifix cubes to represent their choices, have children poll each other on their favourite food, game, and so on. Then have them present their findings to the class.

SUGGESTED ASSESSMENT STRATEGIES

To understand data analysis, children must be actively involved in collecting and displaying information. Assessment should focus on the children's ability to take part in the whole-group discussion, their ability to make sense of the data presented by their classmates, and their skill in posing relevant questions.

Observe

- To what extent does the student show interest in collecting data for various purposes?
- Is the student able to work independently or collaboratively to systematically gather data, organize objects, and create a graph?
- What are the different ways that the student uses to sort and re-sort?
- How does the student explain the graph? What kind of language is used? How much detail is given? How is the information organized?
- How does the student explain why things are sorted in certain ways?
- What kind of information is the student able to get from the graph?

Assessment Tools

- The following tools can be used to assess student learning:
  - observation charts
  - interview sheets
  - portfolios and journals
  - videos and photos

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- A Collection of Math Lessons
- Critters
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Interactions 1
- Math and Literature
- Math Excursions 1: Project-Based Mathematics for First Graders
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Mathematical Games Made Easy
- Mathematics From Many Cultures
- Mathworks Book A
- Quest 2000: Exploring Mathematics Grade 1
- Quest 2000: Exploring Mathematics Level K
- Reusable Classroom Graphing Kit
- Sense-Able Science

Video

- Mathematics: What Are You Teaching My Child?
- The Private Eye

Multimedia

- Interactions Kindergarten

Games/Manipulatives

- Abacus
- Matheggs
- Pegboards and Pegs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will describe concepts of chance and chance events using ordinary vocabulary.

It is expected that students will:

- predict the chance of an event happening using the terms *never*, *sometimes*, and *always*

SUGGESTED INSTRUCTIONAL STRATEGIES

Children expect certain things to happen and are often disappointed or surprised when they don't. Opportunities to explore and notice the things that always happen, those that sometimes happen, and those that never happen help children to understand probability.

- As a class, discuss what everyone did before coming to school and identify the things that were common to every person. For example, everyone got out of bed and came to school.
- Ask questions like the following:
  - On a school day, what do you do every morning?
  - What would you never do?
  - What might you do some days but not every day?
- Suggest a situation and then ask students questions about it related to probability. For example: It is raining outside. What kinds of things would you always see outside on a rainy day? What would you sometimes see? What would you never see?

SUGGESTED ASSESSMENT STRATEGIES

Students show that they are making sense of concepts such as *never*, *sometimes*, and *always* when they begin to use the terms appropriately. Listening in on their conversations and asking questions will help you know if the child is getting a good sense of the meanings of these terms.

Observe

- Create situations in connection with daily activities or stories and invite students' predictions. Note when students are able to make reasonable predictions as to whether an event will or will not happen, and to explain why.
- Ask children to complete sentences such as:
  - I always _____.
  - I sometimes _____.
  - I never _____.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- A Collection of Math Lessons
- Interactions 1
- Math and Literature
- Math Excursions 1: Project-Based Mathematics for Kindergartners
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mathworks Book A

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions Kindergarten

Games/Manipulatives

- Matheggs

PRESCRIBED LEARNING OUTCOMES

It is expected that students will develop a number sense for whole numbers from 0 to 1000 and common fractions to tenths.

It is expected that students will:

- estimate and then count an increased number of objects in a set, and compare the estimate with the actual number
- skip count forward and backward by 2s, 5s, 10s, 25s, and 100s to 1000, using starting points that are multiples; and skip count forward using random starting points
- recognize, build, compare, and order sets that contain 0 to 1000 elements
- round numbers to nearest 10 and 100
- read and write number words to 100 and numerals to 1000
- use ordinal numbers to 100
- explore, represent, and describe numbers to 1000 in a variety of ways, including the use of calculators and computers
- demonstrate place-value concepts concretely and pictorially to give meaning to numbers 0 to 1000
- demonstrate whether a number is even or odd
- recognize and explain whether a number is divisible by 2, 5, or 10
- demonstrate and explain in a variety of ways an understanding of halves, thirds, fourths, fifths, and tenths as part of a region or a set

SUGGESTED INSTRUCTIONAL STRATEGIES

As students progress through the primary grades, they continue to consolidate their understanding and use of numbers to describe real-world situations. Many measurement, geometry, and data analysis situations provide contexts for students to use numbers in meaningful ways. With experience, students begin to feel comfortable working with increasingly large numbers and learn to use a wider variety of ways to represent their understanding of numbers. It is important to give students interesting questions to explore, suitable materials with which to investigate the questions, and a climate that encourages them to discuss ideas.

- Have the children estimate the number of beans, blocks, or beads in a container. After they have estimated the number, have them count using a place-value mat to display 10s and 1s. Provide them with record sheets that include the following:
  - Estimate: I think there are _____ beads in the jar.
  - Count: There are _____ beads in the jar.
- Have students use materials to represent or demonstrate number ideas in activities like the following:
  - Build a 1000 display using ten bowls of cereal containing 10 baggies, each with 10 pieces of cereal.
  - Construct a 1000 line from Unifix/Multilink materials.
  - Represent a given number by cutting and gluing place-value pictures of 100s, 10s, and 1s.
- Have students write about and illustrate their understanding of ordinal numbers in their math journals.
- Divide an apple among four children. Discuss the process of cutting the apple and how to determine how much each student gets. Ask: If two students combine their portions, how much of the apple do they have? Have students create similar situations such as dividing a length of yarn among groups of three, five, or ten students. Explore fractional concepts by asking questions like:
  - Are all of the pieces equal in size?
  - What fraction or part of the whole do you have?
  - One piece is what fraction of the whole?

SUGGESTED ASSESSMENT STRATEGIES

Encourage students to talk and write about what they have learned about numbers. Their paper and pencil recordings should be a direct extension of their exploration of numerical relationships using manipulatives. You can also obtain evidence of students' number sense by observing and talking to them as they organize and use objects and by looking over collections of their work. As students are increasingly able to communicate using the written word and numerical equations, this too can give you a clearer sense of what they understand.

Observe

- As children are engaged in estimating activities, notice who is participating and listen in on their conversations. For clues to their understanding, listen to how they use words that represent quantity (e.g., *longer* instead of *heavier*).

Question

- Pose questions that require visualization. For example: How many toes do four children have?
- Ask students to explain how they would teach a younger brother or sister to understand the meaning of 100s, 10s, and 1s in place value.
- As students work with models for numbers, probe their understanding and the processes they are using by asking questions such as:
  - Why does this show 125?
  - What are other ways to show this number?
  - Is there a pattern?

Collect

- Collect samples of students' self-assessments. To what extent is there agreement among their self-assessments and your assessments of their work?

Reflect

- Which children appear to value the work they produce?
- Which children apply their learning to new situations?

RECOMMENDED LEARNING RESOURCES

Print Materials

- 101 Winning Ways with Base 10 Grades 1–3
- 20 Thinking Questions for Base Ten Blocks
- 20 Thinking Questions for Pattern Blocks
- Bats Incredible
- Box Cars & One-Eyed Jacks
- A Collection of Math Lessons
- Constructing Ideas About Counting
- Cooperative Problem Solving
- Developing Number Concepts Using Unifix® Cubes
- Jaw Breakers and Heart Thumpers
- Interactions 3
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematical Problem Solving in the Primary Grades
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mental Math in the Primary Grades
- Number Activities Resource Bank Ages 4–9
- Overhead and Underfoot
- Place Value
- The Problem Solver 3: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 2
- Quest 2000: Exploring Mathematics Grade 3
- The Show & Tell GeoBoard Collection
- Writing Mathematics Grade 3

Video

- Mathematics: Assessing Understanding
- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions 2

Software

- Primary Number Play
- In Search of Spot - Episode 1

Games/Manipulatives

- Matheggs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use a variety of strategies to apply a basic operation (+, −, ×, ÷) to whole numbers and use these operations in solving problems.

It is expected that students will:

- demonstrate and describe the processes of addition and subtraction of whole numbers up to 1000 with and without regrouping, using manipulatives, diagrams, and symbols
- explore and demonstrate the processes of multiplication and division up to 50, using manipulatives, diagrams, and symbols
- recall addition and subtraction facts up to 18 and multiplication facts up to 25

It is expected that students will choose, use, and defend the appropriate calculation strategy or technology to solve problems.

It is expected that students will:

- calculate and justify the methods they used to find sums, differences, products, and quotients using estimation strategies, mental math techniques, manipulatives, algorithms, and calculators
- verify their solutions to problems by using inverse operations, estimation, and calculators

SUGGESTED INSTRUCTIONAL STRATEGIES

Students develop an understanding of the basic operations by doing meaningful tasks. In addition to developing proficiency with the mechanics of the operations, they need to develop skills that extend beyond computational facility. These skills include analysing complex problem-solving situations, knowing when to select operations, and analysing the reasonableness of the solution. Students also need to be able to determine whether an exact or approximate answer is required and which method is the most appropriate in any given situation. Problem-solving contexts motivate students to develop computational skills that they can apply in new situations.

- Have students act out multiplication situations using classroom activities. For example, have some children act out the following situation to arrive at the answer: If students are working in groups of two, and there are four groups of two, and each student needs a calculator, how many calculators do they need? On the chalkboard, introduce multiplication as repeated addition. Show this as $2 + 2 + 2 + 2 = 8$ and then $4 \times 2 = 8$.
- Construct sets of objects to demonstrate multiplication situations.
- Have children experience real sharing opportunities as readiness for division (e.g., twelve carrot sticks for three children). Then have children divide objects from a random number of objects.
- Encourage students to make estimations of computations and then check the closeness of their estimates to the correct answer with calculators or with the work of other students.

SUGGESTED ASSESSMENT STRATEGIES

Throughout the day, children make choices about how and when to use numbers and number operations. They exhibit their skills and understanding as they work and play, as well as when they are prompted to focus on mathematical tasks. As teachers present problem situations to students, they can assess students' ability to choose the appropriate operations as well as their ability to carry them out. Students who voluntarily introduce numbers into other activities are generally confident of their developing skills.

Observe

- As students demonstrate ways of answering multiplication questions, watch for evidence that they are able to show multiplication as repeated addition or grouping. Note which students use mathematical terms voluntarily and correctly in their explanations.
- Compare students' estimations to their calculations. Are they close?

Question

- Ask students to describe situations both inside and outside of school in which they use various number operations and technology. For example:
  - Tell me about a time when subtracting helped you do something?
  - When does your mother use multiplication at home or in her job? How does she go about it? Try to find out and tell us.
  - List the ways in which people we have been learning about (e.g., the Inuit, community helpers) might need to use division (or another number operation).

Collect

- Ask students to keep dated collections of their work that include number operations. Ask them to choose examples from their portfolio that will show that they understand number operations.

RECOMMENDED LEARNING RESOURCES

Print Materials

- 20 Thinking Questions for Base Ten Blocks
- 20 Thinking Questions for Pattern Blocks
- Activity Math: Using Manipulatives in the Classroom
- A Collection of Math Lessons
- Constructing Ideas About Counting
- Cooperative Problem Solving
- Critters
- Developing Number Concepts Using Unifix® Cubes
- Division
- Interactions 3
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math and Literature
- Mathematical Problem Solving in the Primary Grades
- Mathtales Level 2
- Mathtales Level 3
- Mental Math in the Primary Grades
- Multiplication
- Overhead and Underfoot
- The Problem Solver 2: Activities for Learning Problem-Solving Strategies
- The Problem Solver 3: Activities for Learning Problem-Solving Strategies
- Problem Solving with Number Tiles
- Quest 2000: Exploring Mathematics Grade 2
- Quest 2000: Exploring Mathematics Grade 3
- Signed Number Cards
- Writing Mathematics Grade 3

Video

- Mathematics: Assessing Understanding
- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions 2

Software

- Secret of the Lost City - Episode 2

Games/Manipulatives

- Abacus
- Pegboards and Pegs

PRESCRIBED LEARNING OUTCOMES

It is expected that students will investigate, establish, and communicate rules for numerical and non-numerical patterns that arise from daily and mathematical experiences, and use these rules to make predictions.

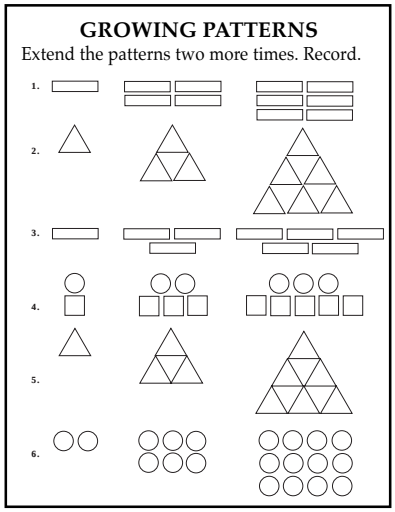
It is expected that students will:

- identify, create, and describe number and non-number patterns
- translate patterns from one mode to another using manipulatives, diagrams, charts, calculators, spoken and written terms, and symbols
- explain the rule for a pattern and make predictions based on patterns using models and objects

SUGGESTED INSTRUCTIONAL STRATEGIES

Through concrete experiences students develop habits of finding, inventing, and using patterns to solve problems. Once they become familiar with repeating and growing patterns, they begin to associate and record numbers for patterns. They develop strategies for analysing and communicating patterns, which can then be connected to other areas such as the graphing of outcomes in data analysis.

- Have students find patterns in the classroom (e.g., on the ceiling, on clothing); create patterns with manipulatives; and represent patterns in different ways, for example, with blocks, words, or illustrations.
- Have students predict patterns. For example, use an overhead projector to project a partial pattern and have children predict the remainder.



Reproduced with permission from *Curriculum and Evaluation Standards for School Mathematics: Addenda Series, Grades K-6: Third Grade Book,* copyright 1992 by the National Council of Teachers of Mathematics.

- Ask students to play the following game in which they each share a calculator with a partner. Starting at 50, they take turns subtracting any one-digit number except zero. The player to reach zero first wins. Can students find a strategy to win? Does it matter who goes first? How do the rules work? Ask students questions such as: Suppose the rules change and the person who first reaches zero loses. How might this change your strategy?

SUGGESTED ASSESSMENT STRATEGIES

Children vary greatly in their ability to recognize patterns intuitively. They need many opportunities to talk about the strategies they use and to hear about the approaches used by others. When children work on problems that lead them into new areas of thought and synthesis (rather than those problems that have a "correct" answer), they predict, test, and talk about their understanding.

Observe

- As students search for patterns in the classroom, notice how they approach the task. Which students seem to be analytical? Which students take a more global approach, looking for an entire sequence or pattern at once? Which seem to be random in their approach? Encourage students to talk about strategies and to experiment with different approaches.

Question

- When students are predicting or extending patterns, probe their strategies and understanding by asking questions such as:
  - How did you decide what would come next?
  - What other possibilities did you consider?
  - Try to think of something else that would work.

Collect

- Students can develop pattern collections in which they keep or record interesting patterns that they find both inside and outside of school. You may wish to brainstorm possibilities or requirements with them, for example: include a pattern that someone in your family uses every day; a pattern that you find on the way to school; a pattern in your kitchen. Note qualities such as the level of complexity and abstraction in the patterns they find, the variation in the patterns they notice, and the language they use to talk about them.

RECOMMENDED LEARNING RESOURCES

Print Materials

- 20 Thinking Questions for Pattern Blocks
- 200 Things to Do with Logic Blocks
- About Teaching Mathematics
- Be SMART: Sorting, Matching, Arranging, Recognizing, Thinking Skills
- Box Cars & One-Eyed Jacks
- A Collection of Math Lessons
- Constructing Ideas About Counting
- Cooperative Problem Solving
- Developing Number Concepts Using Unifix® Cubes
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Gobble Up Math
- Interactions 3
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematics Key Stage 1 Ages 5–7
- The Problem Solver 2: Activities for Learning Problem-Solving Strategies
- The Problem Solver 3: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 2
- Quest 2000: Exploring Mathematics Grade 3
- The Show & Tell GeoBoard Collection
- Writing Mathematics Grade 3

Video

- Mathematics: What Are You Teaching My Child?
- The Private Eye

Multimedia

- Interactions 2

Software

- In Search of Spot - Episode 1
- Primary Number Play

Games/Manipulatives

- Architek (English Version)
- Matheggs

PRESCRIBED LEARNING OUTCOMES

It is expected that students will measure, estimate, and compare, using whole numbers and non-standard and standard units of measure.

It is expected that students will:

- estimate, measure, record, compare, and order objects and containers using non-standard and standard units
- construct a shape, length, or object using a specific non-standard or standard unit
- select the most appropriate standard unit for measuring length (cm, m, km), mass (g, kg), volume (L), and time (minutes, hours, days)
- describe relationships among various standard units of measure
- relate the size of units to the number of units needed when measuring
- recognize that the size and shape of an object does not necessarily determine its mass
- make connections among manipulatives, diagrams, spoken terms, and written symbols
- estimate and measure the passage of time in terms of seconds, minutes, hours, days, weeks, months, and years and relate the various measures to each other

SUGGESTED INSTRUCTIONAL STRATEGIES

The key to children's development of measurement concepts is concrete experience and practice. Through these experiences, students in the late primary years learn to select the appropriate standard units of measurement for specific applications. All students need to develop the ability to use measuring tools and to estimate with these tools.

- Have students bring in a variety of beverage containers, such as tetrapak juice containers, 1 L milk containers, or 2 L drink bottles. Have them work together to estimate and record the volumes of the containers. They can read the labels to determine the actual volume of the containers and then arrange the containers from greatest volume to least volume. Provide students with opportunities to sort and order using different units of measure.
- Students can use Cuisenaire rods or base-ten blocks to measure specific objects in the classroom (or somewhere else in the school) and record their findings on a class chart. Following each measure, have them use a metric ruler to compare standard and non-standard measurements.
- Have students use a mass balance to find objects that equal 1 g or 1 kg, or use gram weights and a balance to measure the mass of objects.

SUGGESTED ASSESSMENT STRATEGIES

Children's talk and actions as they work with and measure objects in the classroom offer insights into their understanding about shape and space. As they work, the teacher's questioning and observing can elicit important feedback on whether students are selecting appropriate tools and if they are measuring with increasing accuracy.

Observe

- Observe students in the process of ordering the containers. What clues or attributes do they seem to rely on? How accurate and precise are they in using comparative language? Which students tend to move towards using numeric values (even if these are not based on standard units)?
- When students use non-standard units to measure classroom objects, watch for evidence that they are systematic and that they recognize the reasonableness of their solutions. Apply the same criteria to standard measures. Discuss anomalies with the group. For example, is an eraser closer to 1 cm long or 10 cm long?

Question

- Ask students to explain why the size of the number changes depending on the unit of measure being used. What volume relationships do they identify among the containers (e.g., four juice containers equal one milk jug)?

RECOMMENDED LEARNING RESOURCES

Print Materials

- 20 Thinking Questions for Pattern Blocks
- Activity Math: Using Manipulatives in the Classroom
- Bats Incredible
- A Collection of Math Lessons
- Critters
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Gobble Up Math
- Interactions 3
- Jaw Breakers and Heart Thumpers
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math and Literature
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematical Problem Solving in the Primary Grades
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mathtales Level 2
- Mathtales Level 3
- Measure It! K-Grade 3
- Mostly Magnets
- Overhead and Underfoot
- Quest 2000: Exploring Mathematics Grade 2
- Quest 2000: Exploring Mathematics Grade 3
- Writing Mathematics Grade 3

Video

- Mathematics: What Are You Teaching My Child?
- The Private Eye

Multimedia

- Interactions 2

Games/Manipulatives

- Pegboards and Pegs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- read and write the date, including the days of the week and use the abbreviations and names of the months of the year in order
- read and write time to the nearest minute using 12-hour notation (use both a digital and an analog clock)
- estimate, read, and record temperature to the nearest degree Celsius
- relate temperature to real-life situations
- identify and use coins and bills (to $100) to estimate, count, record collections, create equivalent sets, and make change up to $10
- read and write both forms of money notation (e.g., 89¢ and $0.89)

SUGGESTED INSTRUCTIONAL STRATEGIES

- Play some music for a set time, such as 30 seconds. Have students listen to the music and then estimate how many times they can complete a given activity (e.g., tie and untie their shoes, hop on two feet) in that period of time. Record their estimates and ask them to test their predictions as the music is played a second time.
- Hang a digital clock beside the analog clock on the classroom wall. Stop at significant moments in the day and read the time, comparing the two clocks.
- Draw pictures of clock faces to show important times of the day at home and at school. Display these pictures under the class clocks so children can match these times as they occur.
- Help students develop their understanding of the place value of coins by playing the following dice-money game. Distribute a record sheet with place columns, one die, and some dimes and pennies to each pair of students. The goal of the game is to end up with as close to $1.00 as possible. For example, one student rolls a 4 on the die, and both students use this number to select either four pennies or four dimes, and place them in the appropriate column. After each player has seven turns, the players add up the coins and check (using paper and pencil or a calculator) to see who is the closest to $1.00.
- Integrate with social studies by exposing the children to coins from other countries.
- Have children watch the evening news and record and compare temperatures from other places in Canada and around the world.

SUGGESTED ASSESSMENT STRATEGIES

Observe

- Over time, make anecdotal observational notes to record the extent to which students' estimates become increasingly accurate. Discuss with students the strategies they used to estimate.

Question

- Informally interview individual children while groups of children play the dice-money game. The following are possible questions to pose:
  - How much money have you got now?
  - How many dimes/pennies do you have now?
  - How many more do you need to reach $1.00?
- Occasionally ask students to keep a written record of each turn and its money amounts.

Collect

- When students are planning projects or ongoing activities (e.g., themes), have them work independently or with a partner to create a work plan or flow chart that includes the amount of time (in appropriate units) that each activity will take. Look for evidence that they understand the units they are using and that the time they spend on the task is reasonable. At the end of the activity, they might write a learning log entry using a prompt such as: Two things I learned about making plans that include time frames are _____ and _____.

Reflect

- What daily applications might help those students who seem to have difficulty with measures of time, temperature, and money?
- What activities might help students build connections to their activities outside the classroom?

RECOMMENDED LEARNING RESOURCES

Print Materials

- 20 Thinking Questions for Pattern Blocks
- Activity Math: Using Manipulatives in the Classroom
- Bats Incredible
- A Collection of Math Lessons
- Critters
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Gobble Up Math
- Interactions 3
- Jaw Breakers and Heart Thumpers
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math and Literature
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematical Problem Solving in the Primary Grades
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mathtales Level 2
- Mathtales Level 3
- Measure It! K-Grade 3
- Mostly Magnets
- Overhead and Underfoot
- Quest 2000: Exploring Mathematics Grade 2
- Quest 2000: Exploring Mathematics Grade 3
- Writing Mathematics Grade 3

Video

- Mathematics: What Are You Teaching My Child?
- The Private Eye

Multimedia

- Interactions 2

Games/Manipulatives

- Pegboards and Pegs
- The Sum-Thing

Prescribed Learning Outcomes

It is expected that students will describe, classify, construct, and relate three-dimensional objects and two-dimensional shapes using common language to describe their properties.

It is expected that students will:

- compare, contrast, sort, and classify two-dimensional shapes and three-dimensional objects using two or more attributes
- identify, count, and describe the faces, vertices, edges, sides, and angles of polygons and solids
- describe and name three-dimensional objects (cubes, spheres, cones, cylinders, pyramids, and prisms) and use appropriate two-dimensional names to describe their faces
- describe and name pyramids and prisms by the shape of the base
- construct skeletons of a three-dimensional object from a model and relate the skeletons (nets) to models
- demonstrate through dismantling that a rectangular solid has more than one net
- make identical, congruent two-dimensional shapes
- construct and rearrange a design using a set of two-dimensional shapes
- recognize congruent three-dimensional objects and two-dimensional shapes in the environment
- explore the concepts of points, lines, perpendicular lines, parallel lines, and intersecting lines on three-dimensional objects

Suggested Instructional Strategies

Children at this age are learning to distinguish the differences between two- and three-dimensional objects. They develop and refine their skills and vocabulary by recounting their experiences with exploring, sorting, and classifying, and by constructing geometric figures.

- Have groups of students sort the sports equipment in the school gym or stationery supplies in the classroom into no more than four categories. Ask the groups to explain their categories and the common attributes or properties of the items in each category. Then have the groups re-categorize the equipment, using different criteria.
- Have students reach into a bag or mystery box to select a three-dimensional item and, without looking at it, describe the item by telling about its faces, edges, corners, and other properties. Encourage other children to guess what the object might be.
- Use collections of three-dimensional objects to introduce vocabulary (cubes, spheres, cones, cylinders, pyramids, and prisms). Ask: What other things can fit into these groups? Why?
- Extend students' ideas about geometry by asking speculative questions, such as:
  - What if there were no (squares, rectangles, triangles) in the world?
  - What things would have to change?
  - What would a grocery store look like if there were no rectangular prisms?

SUGGESTED ASSESSMENT STRATEGIES

The physical world is filled with an array of two- and three-dimensional shapes and objects. Exploration with these shapes and objects provides students with opportunities to generalize to other contexts. As students become more proficient in identifying and classifying these objects, their ability to use appropriate language in their conversations improves. Thus, observation and conversation are the most useful means to identify student progress in this area.

Observe

- Observe students as they sort and classify objects in a variety of situations. Use a checklist or observation form to document this information. Note how individual students approach the task:
  - What attributes do they tend to start with?
  - What other attributes do they focus on? How fluent are they in describing attributes?
  - To what extent do they use a systematic approach?
  - How precise is their language in describing the objects and their attributes?
  - How accurately and precisely do they use comparative language?
  - How broad or narrow are their categories?
  - Which students are easily able to sort by two or more attributes? Which students look for subtle differences as a basis for sorting?
  - How flexible are they in their approaches? (Which students focus on the same attributes or use the same system in all situations? Which students appear to vary their methods deliberately? Which students appear to work in a random way?)
  - To what extent are they able to generalize about the categories they create? (Are they able to name or label their categories? How appropriate or precise are their labels?)

RECOMMENDED LEARNING RESOURCES

Print Materials

- 20 Thinking Questions for Pattern Blocks
- Activity Math: Using Manipulatives in the Classroom
- Circles and Spheres
- A Collection of Math Lessons
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Geometry Grade 2
- Geometry Grade 3
- Gobble Up Math
- Interactions 3
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Math and Literature
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematical Problem Solving in the Primary Grades
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Measure It! K-Grade 3
- Quest 2000: Exploring Mathematics Grade 2
- Quest 2000: Exploring Mathematics Grade 3
- Squares and Cubes
- Writing Mathematics Grade 3

Video

- Mathematics: What Are You Teaching My Child?
- The Private Eye

Multimedia

- Interactions 2

Games/Manipulatives

- Pegboards and Pegs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use positional language, numbers, and directional words to describe the relative positions of objects in one dimension and to communicate motion in real-world contexts.

It is expected that students will:

- communicate and apply positional language and cardinal directions (relating to compasses and maps) in verbal, written, or numerical form
- graph whole number points on a horizontal or a vertical number line
- trace a path on a line following oral or written instructions
- make congruent shapes and symmetrical two-dimensional shapes using folds and reflections

SUGGESTED INSTRUCTIONAL STRATEGIES

As students become more aware of their environment and of how movement affects it, they are better able to explore position and direction in a more abstract way. They are able to view the position of objects in relation to other objects and no longer have to connect the position of objects directly to their own position. Experiences that allow students to move themselves and other objects in space help them develop the ability to view things from varying perspectives.

- Provide experiences to help students understand and correctly use the language of shapes and to become increasingly able to view them in an abstract way:
  - Involve students in activities and games on the playground and in the gym that use positional language such as *by*, *near*, *behind*, *north*, and *south*. Games could come from a variety of cultures (e.g., First Nations' L'hal game).
  - Make up positional activity cards for children to use in pairs. Taking turns, each student reads the directions noted on a card, and the other follows them. Have students summarize their experience by writing about, for example, the funniest part of the game or the most difficult part.
  - Have children label north, south, east, and west in the classroom.
  - Discuss with children the location of surrounding towns in relation to the town where they live. Follow up by using and making simple maps of the local area.
- Have students look for symmetry in the letters of the alphabet. Show them some examples and then ask: How many letters are symmetrical? Use a mirror to help students see which letters are symmetrical. You may also wish to use letters from a variety of languages (e.g., Chinese, Arabic).
- Have students create symmetrical pictures in art by first folding paper, and then cutting out shapes.

SUGGESTED ASSESSMENT STRATEGIES

Children reveal their understanding of positional language and concepts as they follow directions, offer suggestions, and talk about the world around them. As they have more and more opportunities to explore and talk about position and direction, they consolidate their understanding and become more confident.

Observe

- As students participate in games, watch for evidence that they recognize and understand positional language in verbal form. Which instructions seem to be most problematic for some children?
- Ask students to work in pairs to reproduce settings from literature or from outside of school using concrete objects (e.g., blocks, play dough). Note their use of positional language as they work. Assign a similar activity in which the partners use pencil and paper to describe their work, or have them describe their work in an informal interview. Record your observations on a checklist or rating scale.

Question

- If you have made maps of your local area, conduct informal interviews with the children in which they locate on the map some of the places that are familiar to them. Prompt them to use directional terms to describe the relative location of two sites (e.g., their homes and the school) and note their use of directional language.

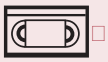
Collect

- Have students collect, record, and label examples of symmetry.

RECOMMENDED LEARNING RESOURCES

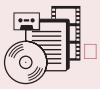
Print Materials

- Geometry Grade 2
- Interactions 3
- Math and Literature
- Mathematical Problem Solving in the Primary Grades
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 2
- Quest 2000: Exploring Mathematics Grade 3
- The Show & Tell GeoBoard Collection



Video

- Mathematics: What Are You Teaching My Child?
- The Private Eye



Multimedia

- Interactions 2

Games/Manipulatives

- Architek (English Version)
- Matheggs
- Pegboards and Pegs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will collect data based on first- and second-hand information, display results in more than one way, interpret data, and make predictions.

It is expected that students will:

- formulate questions and categories for data collection and actively collect first-hand information
- use a variety of methods to collect and record data, including measuring devices, printed resources, and tallies
- sort and organize data by one or more attributes and by using graphic organizers such as lists and charts
- identify attributes and rules in pre-sorted sets
- display data in more than one way, including graphs, pictographs, bar graphs, and rank ordering
- discuss data, communicate conclusions, and make predictions and inferences to solve similar problems
- generate new questions from displayed data
- obtain new information by performing arithmetic operations on the data

SUGGESTED INSTRUCTIONAL STRATEGIES

Students' questions about the physical world can often be answered by collecting first-hand information. This allows them to broaden their view of mathematics and its usefulness. As they learn how to collect, organize, display, and share information in the form of graphs, they develop critical-thinking skills that allow them to make predictions, decisions, and conclusions about their information.

- Numerous opportunities exist in the classroom for first-hand data collecting: numbers of boys and girls, ages in years, months of birthdays, numbers of letters in first names, favourite colours, transportation to school, favourite animals. Present and discuss samples of different ways in which people record data (e.g., tables, lists, charts). Have students select a method to record their data and develop graphs to display their information. Have students explain their choice for data collection, recording, and grouping and discuss what information can be retrieved from their graphs, for example:
  - What appears most/least often?
  - What conclusion can we make?
  - What predictions can we make?
  - What other questions are now raised?
- Use the activity What's My Rule? Sort objects into hoops on the floor and have students observe and state the possible attributes that you used to sort the objects.

SUGGESTED ASSESSMENT STRATEGIES

The assessment of students' learning should describe their increasing ability to create and interpret graphs and charts. As students integrate their understanding of the procedures and purposes of data analysis, they will apply their knowledge in new situations, both within mathematics and in other subject areas.

Question

- When students are working on a data collection project, questions such as the following can help them clarify and demonstrate their skills and understanding:
  - How can you get the information you need? What other methods could you use?
  - How will you record the information? Are there any other ways that you could write down what you find out? Which way would be easiest to understand?
  - What ways could you use to share your results with the class? How many different ways can you think of? Which way would be fastest? Which way would give others the most information?
- After students have completed a data collection project, questions such as the following can help them reflect on the processes they used and inform you of their learning:
  - What were some of the things you found out in your survey? Did any of them surprise you?
  - What part of your project was the most interesting for you?
  - Did you learn to do anything you hadn't tried before? Tell me about it.
  - What were some of the decisions you made? Which ones were difficult to make? How did you decide what to do? Would you make the same decision again?
  - How did your presentation turn out? Where else could you use the same kind of graph or display?

Self-Assessment

- Have students self-assess their graphs based on criteria developed with the class, such as data clearly displayed and accuracy.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Bats Incredible
- Box Cars & One-Eyed Jacks
- A Collection of Math Lessons
- Critters
- Exploring Everyday Math: Ideas For Students, Teachers and Parents
- Gobble Up Math
- Interactions 3
- Jaw Breakers and Heart Thumpers
- Math and Literature
- Math Makes Sense
- Mathematical Games Made Easy
- Mathematical Problem Solving in the Primary Grades
- Mathematics From Many Cultures
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Mostly Magnets
- Overhead and Underfoot
- Probability
- The Problem Solver 2: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 2
- Quest 2000: Exploring Mathematics Grade 3

Video

- The Private Eye

Multimedia

- Interactions 2

Games/Manipulatives

- Abacus
- Matheggs
- Pegboards and Pegs
- The Sum-Thing

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use simple experiments designed by others to illustrate and explain probability and chance.

It is expected that students will:

- describe the likeliness of an outcome using terms such as *likely*, *unlikely*, *fair chance*, *probable*, and *expected*
- conduct a probability experiment, choose an appropriate recording method, and draw conclusions and make predictions from the results

SUGGESTED INSTRUCTIONAL STRATEGIES

Uncertainty is part of our daily lives. Many of our decisions are based on our informal predictions concerning the likeliness of certain events occurring. As students become more aware of the likelihood of certain events happening, they can begin to collect and record data that help them to discover patterns around the frequency of events. This will allow them to begin to make predictions.

- Have students use the terms *likely*, *unlikely*, *fair chance*, *probable*, and *expected* in a school context. For example: It is _____ that there will be a hot dog sale next month.
- Choose possible-chance questions that are of interest to this age group. Give students cards with words on them such as *likely* and *unlikely*. Have them hold up the card with the most appropriate answer as you ask questions. For example: How likely is it that someone in our room:
  - has on a Band-Aid?
  - plays an instrument?
  - has travelled to another country?
  - came to school on an airplane?
  - has a soccer game next week?
- Provide opportunities to explore chance.
- Play Counters Away. Students have 11 counters that they can place on a number line of 2 to 12. For example, they may place three counters on number 5, four counters on number 8, and one each on 9, 10, 11, and 12. Two dice are rolled. The counters on the number of the sum of the dice are removed. The object is to be the first to have all of his/her counters removed.

SUGGESTED ASSESSMENT STRATEGIES

By exploring probability and chance through games and experiments, students are encouraged to make predictions about events. They can adjust and adapt experiments to answer their own questions about why certain events happen. As they play these games and do these experiments, they can write or talk about their predictions, why they made such predictions, and what actually occurred. From this, they begin to view their world as a combination of events that they can understand, and sometimes influence, and others that are chance occurrences.

Observe and Question

- Pose questions such as those listed under "Suggested Instructional Strategies" in discussions and informal interviews. Watch for evidence of:
  - students' interest in making predictions
  - their ability to tailor their responses to specific questions rather than, for example, making the same predictions again and again
  - whether or not they are exploring systematic ways of responding
  - the frequency of unreasonable answers
  - their use of vocabulary (e.g., *probably*, *expect*, *likely*)
  - their willingness to speculate about ways to verify their predictions
- When they are playing Counters Away, observe:
  - to what extent students appear to be calculating possible outcomes based on their understanding of the probability of dice rolls
  - to what degree they can describe their strategy for winning the game

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- A Collection of Math Lessons
- Division
- Interactions 3
- Math and Literature
- Mathematical Games Made Easy
- Mathematical Problem Solving in the Primary Grades
- Mathematics in the School Grounds
- Mathematics Key Stage 1 Ages 5–7
- Probability
- Writing Mathematics Grade 3

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- Interactions 2

Games/Manipulatives

- Matheggs

PRESCRIBED LEARNING OUTCOMES

It is expected that students will demonstrate a number sense for whole numbers from 0 to 10 000 and for proper fractions.

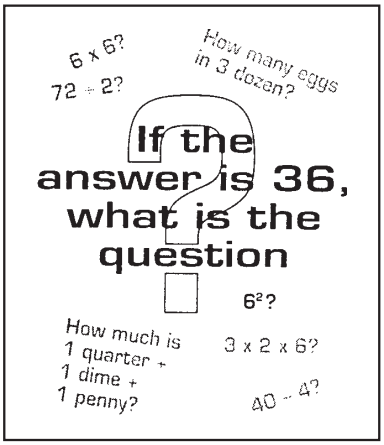
It is expected that students will:

- estimate and then count the number of objects in a set (0 to 1000), and compare the estimate with the actual number
- use skip counting (both forward and backward) to support their understanding of pattern in multiplication and division
- compare and order numbers up to 10 000
- read and write number words to 1000
- round numbers to the nearest 10, 100, and 1000
- represent and describe numbers to 10 000 in a variety of ways
- demonstrate concretely, pictorially, and symbolically place-value concepts to give meaning to numbers up to 10 000
- sort numbers into categories using one or more attributes
- demonstrate an understanding of hundredths as part of a region or set
- connect proper fractions to decimal fractions (tenths and hundredths) using manipulatives, diagrams, and symbols

SUGGESTED INSTRUCTIONAL STRATEGIES

The ability to understand and use numbers in computation, measurement, and estimation situations takes many years to develop. In Grade 4, students begin to consolidate their understanding of whole numbers and are introduced to fractions and decimals. Students should be encouraged to use estimation and mental arithmetic as they apply their learning to day-to-day tasks. Daily warm-up activities help sharpen students' number sense.

- Provide students with materials such as base-ten blocks and have them explore the relationships among the sizes of the cubes, rods, and flats. Have students build models to represent numbers, changing the value of the centimetre cubes as required.
- To help students understand the real-world applications of their learning, ask them to do activities such as bringing to class a wide variety of the large numbers that they can find in newspapers and magazines, and then having them discuss the meaning and size of the numbers used.
- Students can show their understanding of numbers by classifying, sorting, and talking about the numbers and the reasons for their classifications.
- Challenge students to write such numbers as those between one-half and one-quarter, or smaller than 0.1, or closer to 1200 than 1100.



SUGGESTED ASSESSMENT STRATEGIES

As in the primary years, the assessment of students' ability to understand mathematical terms and concepts is best achieved through a natural extension of instructional activities. Learn the extent to which students demonstrate a number sense for whole numbers and proper fractions by observing what students do as they work on activities, listening to them as they work together or answer questions, and looking at and discussing their completed work.

Observe

- Observe students as they use blocks to build models for a number. Do they represent place value with an appropriate block?
- Given pictures of base-ten blocks, have students write the correct numeral.

Question

- Gain a sense of students' level of understanding by asking questions to probe their number sense. For example, ask students: Is a price of $289 reasonable for a new luxury car?
- Ask students to explain the fractional values of pieces shown in their drawings or patterns.

Collect

- Have students place their work in their portfolios. Review a series of their work samples to assess their progress in terms of accuracy, complexity of calculations, and variety of representation.

RECOMMENDED LEARNING RESOURCES

Print Materials

- 101 Winning Ways with Base Ten Grades 4–6
- Cooperative Problem Solving
- Get to the Point
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- Mental Math in the Middle Grades
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 4
- The Show & Tell GeoBoard Collection

Video

- Mathematics: Assessing Understanding
- Mathematics: What Are You Teaching My Child?

Games/Manipulatives

- Box Cars & One-Eyed Jacks
- Discovery Kit - Fraction Pieces
- Fraction Stax

CD-ROM

- Math Made Fun

PRESCRIBED LEARNING OUTCOMES

It is expected that students will apply arithmetic operations on whole numbers and illustrate their use in solving problems.

It is expected that students will:

- demonstrate and describe the process of addition and subtraction of numbers up to 10 000, using manipulatives, diagrams, and symbols
- demonstrate the process of multiplication (three-digit by one-digit numbers), using manipulatives, diagrams, and symbols
- demonstrate the process of division (two-digit by one-digit numbers), using manipulatives, diagrams, and symbols
- recall multiplication and division facts up to 81

SUGGESTED INSTRUCTIONAL STRATEGIES

Understanding how number operations relate to real-world experiences is critical to being able to solve problems, and this understanding also forms the basis for the future learning of algebra. Knowing "how and why" deepens students' understanding of mathematics. Thus, it is important to select activities that focus on interesting questions and problem situations that encourage students to apply their mathematical understanding in appropriate and efficient ways.

- In small groups, have students share a tub of base-ten blocks. Have them place numerals on place-value mats. Then have them add or subtract further numbers to or from these on the mats.
- Have students talk about how they use addition and subtraction in their daily lives and how they see adults using these skills. This could be done in groups, with each group reporting to the class.
- Have students create transformations based on an example such as:

  $3 \times 246 = (3 \times 200) + (3 \times 40) + (3 \times 6) = 738$
  $246 + 246 + 246 = 738$
  $3 \times 246 = 738$

  Have them use calculators to check the products and to see that the products are the same in each example.
- Have students take a variety of objects (up to 50) and divide them into various numbers of equal-size groups. Then have them record the results.
- In groups, have students discover, study, and discuss patterns and connections in the times tables to help them learn both multiplication and division facts.

SUGGESTED ASSESSMENT STRATEGIES

Watching students as they work individually and in groups provides opportunities for noting the extent to which they have refined their ideas and understanding. The questions they ask and the suggestions they offer can reveal a great deal about their understanding and confidence with number operations.

Observe

- Watch students as they work with base-ten materials and note which students are regrouping numbers as needed and which are regrouping with both addition and subtraction.
- Have students devise and solve story situations in which they need to divide to get the answer. How do they approach the activity (eagerly, immediately, cautiously)? Do they demonstrate the process of division by using manipulatives, diagrams, or symbols?

Record

- Have students work in groups to make booklets or use audio-visual equipment to make presentations about how and why people use mathematical operations in their daily lives (at home, at work, or in the community). To what extent do students share materials, ask one another questions, and assist one another? To what extent do students understand the range of applications of mathematics to everyday activities?

RECOMMENDED LEARNING RESOURCES

Print Materials

- 101 Winning Ways with Base Ten Grades 4–6
- Big Magic Number Puzzles
- Box Cars & One-Eyed Jacks
- Collectors' Clubhouse
- Cooperative Problem Solving
- Creative Maths Age 7–9
- Division
- Electrical Connections
- Interactions 4–6
- The Maharajas' Tasks
- Mathematics From Many Cultures
- Mental Math in the Middle Grades
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Problem Solving with Number Tiles
- Quest 2000: Exploring Mathematics Grade 4
- Trading Post Module Notes

Video

- Mathematics: Assessing Understanding

CD-ROM

- Math Made Fun

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- justify their choice of method for multiplication and division (using estimation, calculators, mental mathematics, manipulatives, algorithms)
- verify solutions to multiplication and division problems by using estimation and calculators
- verify solutions to multiplication and division problems by using the inverse operation

It is expected that students will demonstrate an understanding of the addition and subtraction of decimal fractions.

It is expected that students will:

- demonstrate an understanding of the addition and subtraction of decimal fractions (tenths and hundredths) by using concrete and pictorial representations

SUGGESTED INSTRUCTIONAL STRATEGIES

Real-life problems often require complex solutions. The ability to understand a problem and to identify and justify a plan for solving it is essential if students are to become flexible thinkers. As students are faced with increasingly complex problems, they better understand the purposes for their calculations, as well as the reasons for choosing specific calculation methods.

- Have students write problems requiring the use of one of the four arithmetic operations. They could work in groups and exchange problems when finished. Have them explain how they approached each problem (estimation, calculators, mental mathematics, manipulatives, algorithms) and justify their answers and the methods they used. For example:
  - To solve this problem I _____.
  - This was a good method to use because _____ . Next time I will _____ , because _____.
- Challenge students with problems that require the use of calculators and large numbers. For example: Suppose you have $10 000 to spend to improve your community. Create a spending plan. List the articles you would buy, how much they cost, and the money you would have left. Have students develop little dramas to demonstrate their spending plans, perhaps using pictures from catalogues or other pictorial representations to illustrate how the money was spent.
- Have students estimate the answers for calculations such as 342×24. Then have them use calculators to check their estimates. After doing such activities, have students work in groups to discuss how they estimated and the methods they used to check their answers.
- Have students make question cards showing the addition or subtraction of decimal fractions. On the backs of the cards, have them represent the answer pictorially.

SUGGESTED ASSESSMENT STRATEGIES

As students engage in various problem-solving activities, ask them questions such as: Why? How would you convince someone? How did you figure that out? These will help students explain and justify their answers or conjectures. Their inability to reason and communicate their reasoning to others will further develop their number sense.

Observe

- Listen to individual students justify the decisions they made while problem solving. Use a checklist to note student's understanding.
- Have students estimate the answers to multiplication questions involving two- and three-digit numbers. Then have them use calculators to find the answers. (e.g., Write down your estimate of the answer for $426 \times 23 + 400 \times 20$. Now use the calculator to check your estimate.) Which students talk about how they came up with their estimates? Which students seem unable to use the calculator to check their estimates? Which seem uninterested in using the calculator?

Record

- Develop and assign projects that require large-scale estimations, such as painting, flooring, or going on a trip. You could have students brainstorm a list of possibilities. Remind students to check their work and include evidence of how they verified their solutions. Assess their work in terms of their choice of operations, the reasonableness of their estimations, and the appropriateness and accuracy of their verifications.
- Videotape the various problems students act out to solve. Have them watch the video and categorize the problems by the operations used (addition, subtraction, multiplication, or division).

Reflect

- Which students were able to justify the calculation strategies or technologies they used when they solved problems?
- How might you have those who are confident and accurate assist those who are not?

RECOMMENDED LEARNING RESOURCES

Print Materials

- 101 Winning Ways with Base Ten Grades 4–6
- Big Magic Number Puzzles
- Box Cars & One-Eyed Jacks
- Collectors' Clubhouse
- Cooperative Problem Solving
- Creative Maths Age 7–9
- Division
- Electrical Connections
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- The Maharajas' Tasks
- Mathematics From Many Cultures
- Mental Math in the Middle Grades
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Problem Solving with Number Tiles
- Quest 2000: Exploring Mathematics Grade 4
- Trading Post Module Notes

Video

- Mathematics: Assessing Understanding
- Mathematics: What Are You Teaching My Child?

CD-ROM

- Math Made Fun

PRESCRIBED LEARNING OUTCOMES

It is expected that students will investigate, establish, and communicate rules for, and predictions from, numerical and non-numerical patterns.

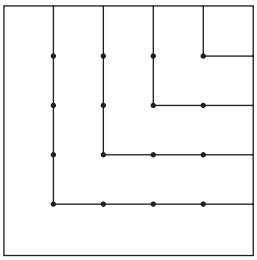
It is expected that students will:

- identify and explain mathematical relationships and patterns through the use of grids, tables, charts, or calculators
- make and justify predictions using numerical and non-numerical patterns

SUGGESTED INSTRUCTIONAL STRATEGIES

As students' abilities to recognize and create patterns become more and more refined, they become more able to use this knowledge to explain relationships. Their ability to use patterns when solving problems is developed further as they systematically investigate a variety of patterns. Students move from a basic recognition of patterns to a more sophisticated use of patterns as a problem-solving strategy.

- Use the 12 × 12 multiplication table to find the patterns for different multiples. Have students work in pairs or groups to colour in the multiples from 2 to 12, with each group having a different multiple. Once complete, discuss the pattern. Ask students questions such as the following: Are any tables similar? What differences do you see? Within one table can you explain why certain numbers are coloured? What do you think the table for 13 or 17 would be like? Why?
- Have students use the geoboard or dot paper to create squares. Ask students to find the different squares in each level of growth.



Level	# of Small Sqs.	Total Squares
1	1	1
2	4	5
3	9	14
4	16	30

- Have students work on a bigger geoboard to continue the pattern and record their findings. Pose questions such as: How many squares are there at the seventh level? At the twelfth level? At the twentieth level? How do you know? Is there a rule that applies?

SUGGESTED ASSESSMENT STRATEGIES

In Grade 4, students move from learning about patterns to applying their understanding of patterns and using patterns in a more formal sense. Their ability to explain the pattern rules they find, and the ways in which they apply those rules in a problem situation, become the focus of the assessment.

Observe

- Ask students to record in their journals their discoveries about various multiplication patterns. Have them make predictions in their journals. Look for clarity in their explanations of why the patterns exist as they do. Note the variety of the patterns identified. Are students' predictions consistent with their discoveries?
- Have students create problems for others to solve. Note the degree of similarity to or variation from the original problems. In subsequent problems, do students use similar charts/tables/graphs to help organize their work?

Record

- Prompt students to reflect on the strategies they used to find patterns. They can use reflection sheets to record their reasoning and explain how they came to the conclusions they did.

Reflect

- Which students seem unable to generalize a rule based on their investigations of patterns, or to describe their reasoning?
- How can you find out if this is because they lack understanding or because they lack the technical language to talk about their ideas?

RECOMMENDED LEARNING RESOURCES

Print Materials

- 200 Things to Do with Logic Blocks
- About Teaching Mathematics
- Box Cars & One-Eyed Jacks
- Cooperative Problem Solving
- Creative Maths Age 7–9
- Electrical Connections
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 4
- The Show & Tell GeoBoard Collection

Video

- Mathematics: What Are You Teaching My Child?

PRESCRIBED LEARNING OUTCOMES

It is expected that students will estimate, measure, and compare quantities, using decimal numbers and standard units of measure.

It is expected that students will:

- construct specific lengths (mm)
- select the most appropriate standard unit (mm, cm, m, km) to measure length
- describe the relationships among mm, cm, m, and km
- estimate, measure, record, compare, and order objects by length, height, perimeter, and circumference using standard units (mm, cm, m, km)

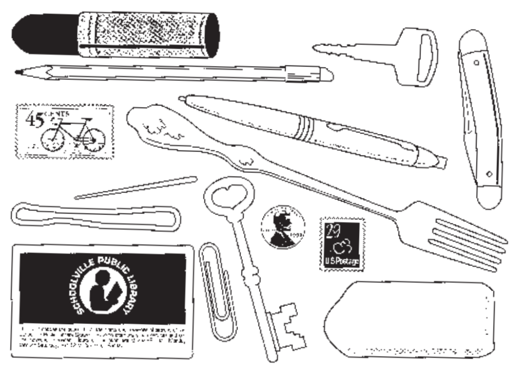
SUGGESTED INSTRUCTIONAL STRATEGIES

The study of measurement provides opportunities for activity-oriented investigations of real-life problems. It also shows students practical applications of mathematics in daily life as well as in other school subjects, such as science and social studies. As students move through the intermediate years, their understanding of standard measurement increases and they become more skilful in their estimating, measuring, and application of measurements.

- Have students list and discuss the uses and tools of measurement that they have seen people using at home and in their communities.
- Have students estimate and measure objects in the classroom using a variety of tools (e.g., string, blocks, base-ten blocks, tape measures, metre-sticks). Have them use this data to compare the objects, ordering them by size, length, or area.

ACTIVITY 1
HOW GOOD IS YOUR ESTIMATE?

Estimation is an important aspect of measurement. For this activity, use the pictures of some common objects shown below.



First, for each object listed in the chart at the right, estimate the described length in centimeters, and enter your estimate in the appropriate column.

Then, when you have estimated all the lengths, use your ruler to measure them and enter the measurement of each object in the right-hand column.

Do you think that you estimate lengths in centimeters well? You can 'see' how well you estimate by graphing your results on the graph paper on the next page.

Object	Estimate	Measure
Length of ballpoint pen		
Length of toothpick		
Width of paper clip		
Length of lipstick case		
Length of library card		
Length of pencil		
Perimeter of library card		
Length of bigger stamp		
Length of pocket knife		
Width of eraser		
Length of rubber band (flat and unstretched)		
Length of fork		
Length of longest key		

SUGGESTED ASSESSMENT STRATEGIES

Students become skilful and confident about measuring when they have frequent opportunities to practise and demonstrate their skills in real-world applications. To identify the extent to which students can estimate, measure, and compare using decimal numbers and standard units of measure, you must observe them and talk to them as well as examine their products.

Observe

- In conversations, which students use the language of standard units of measure accurately?

Question

- Ask students to explain what they are doing while using measurement tools, building constructions, or completing written tasks. For example: Why did you use centimetres to measure that?

Collect

- Have each student make a learning log entry about measurement to explain, for example, how they used measurement when they constructed something or when they worked on a hobby. Ask them to recount what worked, what went wrong, and what they would do differently next time. What do their responses tell you about their understanding of estimating, measuring, and comparing quantities?

Reflect

- Which students are not yet able to use decimal numbers and standard units of measure to estimate, measure, and compare? What additional experiences might help?
- Which students are confident and accurate in the use of decimal numbers and standard units of measure? What activities might extend their knowledge or help them make connections to other mathematical topics and applications of measurement?

RECOMMENDED LEARNING RESOURCES

Print Materials

- Budding Botanist
- Electrical Connections
- Fire Hall
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Polyhedraville
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Problem Solving with Pentominoes
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 4
- Underwater World Module Notes

Video

- Mathematics: What Are You Teaching My Child?

Software

- Turtle Math Set

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- estimate, measure, record, compare, and order shapes by area using standard units (cm^2, m^2)
- construct a number of shapes given a specific area (cm^2)
- select the most appropriate standard unit to measure area
- relate the number of units needed to the size of the units to measure the area of an object
- estimate, measure, record, compare, and order the capacity of containers using standard units (mL, L)
- relate the number of units needed to the size of the units to measure the mass of an object

SUGGESTED INSTRUCTIONAL STRATEGIES

- Have students determine the surface area of objects in their environment using a variety of materials (e.g., base-ten blocks, grids).
- Ask students to use tiles, blocks, grids, and other materials to explore area and volume.
- Have students use geoboards or computer software (e.g., Logo) to construct figures of equal area.
- Have students use base-ten blocks to determine the volume of regular solids (e.g., cereal boxes, cubby holes, geometric shapes).
- Ask students to use measuring containers and coloured water or sand to determine the capacity of different containers.

SUGGESTED ASSESSMENT STRATEGIES

Observe

- Have students find and present problems that involve them in determining the floor or wall area of a room in their home. (e.g., What would it cost to put carpet in your bedroom?)
- Ask students to prepare a data grid and present it to their peers. Encourage other students to ask clarifying questions and to explore the methods that the presenter used.
- Observe students as they measure volume or capacity in connection with a problem they need to solve.

Question

- Ask students to explain the way they have ordered information. Encourage them to find ways to verify or confirm their ordering and invite them to speculate about other methods they might have used.

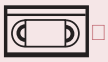
Collect

- Challenge students to represent the same area in as many different figures as they can construct. Collect their work and look for evidence that they understand and can apply the concept of equivalence.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Budding Botanist
- Electrical Connections
- Fire Hall
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Polyhedraville
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Problem Solving with Pentominoes
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 4
- Underwater World Module Notes



Video

- Mathematics: What Are You Teaching My Child?

Software

- Turtle Math Set

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

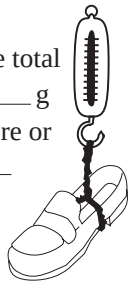
- describe the relationship between grams and kilograms
- solve problems involving mass using grams and kilograms
- relate years, decades, centuries, and millenniums
- read and write time on a 24-hour clock
- read and write time using a.m. and p.m.
- estimate, count, and record collections of coins and bills up to $100
- make purchases and change up to $100

SUGGESTED INSTRUCTIONAL STRATEGIES

- Have students choose a number of objects and then estimate and determine the mass of each using a balance or scale.
- Have students use digital and analog clock faces to represent time.
- Ask students to use stopwatches to measure elapsed time (e.g., the time to walk to the washroom, office, or bus stop).
- Have students use money trays to select and purchase items from newspapers, magazines, and catalogues, and to make change.

How Much Does Your Shoe Weigh?

1. My shoe weighs_____ g.
2. Use the results of part 1 to find the total weight of your pair of shoes. _____ g
3. Does your pair of shoes weigh more or less than 1/2 a kilogram?_____



Guess the Weight

1. Pick a container and compare its weight with the 1-gram (small cubeogram) or 50-gram weights.

Guess its weight. _____ g

2. Now check the bottom of the container for the actual weight _____ g
   How far off was your guess? _____ g
3. Try with another container
   Guess: _____ g
   Weight: _____ g
   Off by: _____ g

SUGGESTED ASSESSMENT STRATEGIES

Question

- Ask students to determine the number of identical items that can be purchased with a given amount of money. (e.g., How much fruit can be purchased with $100? How much money will be left over?)

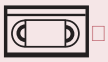
Collect

- Assign a series of questions that require students to present the same data in both grams and kilograms. Check for accuracy and for the reasonableness of students' answers.
- Provide students with a series of objects. Have them work in pairs to calculate the mass of each and order the results. After they have completed the activity, have each student write in a learning log or journal about what they did and what they found. Alternatively, you could have students calculate and order the elapsed time of some common activities (e.g., a schoolyard run, the walk to school).
- Have each student prepare and present a travel itinerary using bus, train, or airline schedules. Check their itineraries for accuracy and consistency in written times and dates.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Budding Botanist
- Electrical Connections
- Fire Hall
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Polyhedraville
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Problem Solving with Pentominoes
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 4
- Underwater World Module Notes



Video

- Mathematics: What Are You Teaching My Child?

Software

- Turtle Math Set

Prescribed Learning Outcomes

It is expected that students will describe, classify, construct, and relate three-dimensional objects and two-dimensional shapes, using mathematical vocabulary to describe their properties.

It is expected that students will:

- design and construct nets for pyramids and prisms
- relate nets to three-dimensional objects
- compare and contrast pyramids and prisms to describe a relationship
- identify and sort specific quadrilaterals, such as squares, rectangles, parallelograms, and trapezoids
- classify angles in a variety of orientations according to whether they are a right angle, less than a right angle, or greater than a right angle
- recognize, draw, and name the following: point, line, parallel lines, and intersecting lines

Suggested Instructional Strategies

When geometric ideas are derived from students' physical world, their study of geometry becomes both practical and enjoyable. By connecting geometric ideas with students' developing spatial sense and with other areas of mathematics, you allow students to broaden their understanding of shape and space, and the world around them. At the Grade 4 level, the use of manipulatives continues to be important for developing geometric ideas. In addition, the use of technology, such as computers, can further enhance students' experiences.

- Have students design and construct three-dimensional pyramids and prisms using available materials (e.g., toothpicks, straws, pipe cleaners).
- Have students use geoboards or other grid materials and work individually or in groups to explore, design, and record all possible quadrilaterals.
- Have students construct a right-angle tester by folding paper twice so that the folded edges line up. Then have them record and classify all angles in the classroom as *less than*, *more than*, or *equal to* a right angle.
- Have students find and identify examples of points, lines, parallel lines, and intersecting segments using photographs from magazines.

SUGGESTED ASSESSMENT STRATEGIES

Students use more sophisticated vocabulary as they actively investigate various complex two- and three-dimensional shapes. They classify angles using technical language and increasingly associate them with the designs they see around them. Your ongoing observations of how students work on their own and in groups, using manipulatives, will provide more accurate evidence of their progress than will your observation of a single event or a single paper-and-pencil test. Use probing questions related to "how" and "why" to discover the level of students' understanding.

Observe

- To what extent can students use manipulatives to demonstrate their understanding of concepts?
- To what extent can students use the language of geometry accurately in oral or written forms?
- To what extent do students persevere in finding many diverse examples of quadrilaterals?

Question

- Encourage students to respond to logical and speculative questions such as:
  - Why do you think that walls are built at right angles to the ground? What would the world be like if all the right angles in objects suddenly disappeared?

  What do their answers reveal about their ability to use mathematical vocabulary to describe properties?

Reflect

- Which students have sufficient understanding of the language to identify, sort, and classify objects and shapes?
- Which students can use mathematical vocabulary to describe properties accurately?
- What experiences would benefit those who are not meeting these goals?

RECOMMENDED LEARNING RESOURCES

Print Materials

- Collectors' Clubhouse
- Creative Maths Age 7–9
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- The Maharajas' Tasks
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Polyhedraville
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 4
- Trading Post Module Notes

Video

- Mathematics: What Are You Teaching My Child?

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use numbers and directional words to describe the relative positions of objects in two dimensions, using real-world contexts.

It is expected that students will:

- communicate and apply terms of directions to maps (north, south, east, and west)
- place an object on a grid using columns and rows
- describe the position of an object on a grid using columns and rows
- trace a path on a grid or map, using oral or written instructions (and vice versa)
- create and verify symmetrical two-dimensional shapes by drawing lines of symmetry

SUGGESTED INSTRUCTIONAL STRATEGIES

To develop their spatial sense, students need many experiences that focus on geometric relationships, directionality, orientation, and perspective. The application of ordinal concepts to maps and models link hands-on classroom experiences with objects and events in the real world. By doing problems that involve precise language, students will be able to practise and apply their understanding of position.

- Have students use compasses to make sketch maps of the schoolyard, their route to school, or part of their community.
- Have students play games like Battleship to gain experience with coordinate grids.
- Have students fold paper, cut out a shape of their own choice along the fold, and then unfold the paper. Have students work in groups to record the shapes made. Challenge students to create unfolded cutouts that match given geometric shapes.

SUGGESTED ASSESSMENT STRATEGIES

To develop their understanding of objects and their position and movement in space, have students actively move themselves or the objects. While students are engaged in these activities, assess their progress by observing and communicating with them on an ongoing basis.

Collect

- Have students make up direction cards or a mini-orienteering course. Examine their work for accuracy, scale, and complexity.
- Have students identify and verify lines of symmetry in a given set of quadrilaterals. Have students work in groups to record and present their data. Look for multiple lines of symmetry. Can students find them all? Which students persevere? Which students give up or partially complete the activity?

RECOMMENDED LEARNING RESOURCES

Print Materials

- Interactions 4–6
- Polyhedraville
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Problem Solving with Pentominoes
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 4
- The Show & Tell GeoBoard Collection

Video

- Mathematics: What Are You Teaching My Child?

Software

- Turtle Math Set

PRESCRIBED LEARNING OUTCOMES

It is expected that students will collect first- and second-hand data, assess and validate the data-collection process, and graph the data.

It is expected that students will:

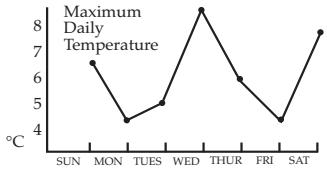
- select an appropriate sample or population and organize the collection of data
- manipulate data to create an interval graph/table for display purposes
- construct a bar graph and a pictograph using many-to-one correspondence and justify the choice of intervals and correspondence used
- evaluate the process by which the data was collected

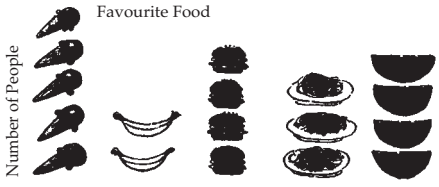
SUGGESTED INSTRUCTIONAL STRATEGIES

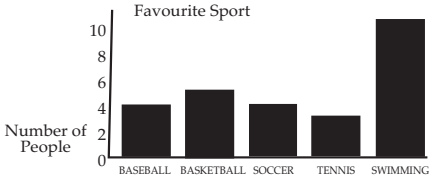
Data analysis provides opportunities for students to see connections among their school subjects and to better understand the information they encounter daily. To answer questions and to make decisions about sets of information, students gather, organize, and present information.

- Discuss with students the various ways to organize and present information.
- Have students collect graphs and pictographs from newspapers and magazines. Discuss what the graphs tell them about the topics so they understand that people use graphs to convey meaning.
- Divide the class into groups of four to six students. Each group is responsible for conducting a survey to answer a question of their choice. Each group must determine how they will collect and display their information. Use questions such as:
  - Who should be included in the survey?
  - What are some of the best ways to collect information?

  When the teams debrief for the whole class, the information can be gathered and used as the basis of criteria to evaluate the process by which the data were collected. After students have completed their collections and graphed the information, have them prepare a set of questions to help others interpret their graphs.







SUGGESTED ASSESSMENT STRATEGIES

Students learn from each other. As they communicate about how they approach various aspects of collecting, interpreting, and displaying data, as well as how they make predictions, they gain insight into a variety of ways to organize, analyse, and use information.

Observe

- Observe whether students can:
  - select appropriate formats to display information so that it can be understood by others
  - select an appropriate sample or population, organize the collection of data, and evaluate the process by which the data were collected

Question

- Have students work in groups to rate the presentation of each other's graphs based on:
  - how well the information was collected
  - how effectively the information was displayed
  - how well the ideas were presented
- Have students work in groups to develop a set of criteria to assess and evaluate their graphs. For example, they might list:
  - spacing of intervals
  - labelling of axes
  - accurate drawing of bars in terms of the information collected
- Have students meet in groups to assess how well they have achieved their goals.

Reflect

- Consider which students had difficulty with one or more aspects of the process: collecting first- and second-hand data, assessing and validating the data-collection process, and graphing the data.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- Electrical Connections
- Fire Hall
- Great Graphing
- In All Probability: Investigations in Probability and Statistics
- Interactions 4–6
- Intermediate Probability Jobcards
- Mathematics From Many Cultures
- Probability
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 4
- Trading Post Module Notes
- Underwater World Module Notes

Video

- Mathematics: What Are You Teaching My Child?

Software

- DataWonder! The Organizing, Graphing and Reporting Tool
- The Graph Club
- Turtle Math Set

Games/Manipulatives

- D.I.M.E. Probability Pack A
- D.I.M.E. Probability Pack B

PRESCRIBED LEARNING OUTCOMES

It is expected that students will conduct simple probability experiments to explain outcomes.

It is expected that students will:

- identify an outcome using the terms *possible, impossible, certain,* or *uncertain*
- compare outcomes using the terms *equally likely, more likely, or less likely*
- design and conduct experiments to answer their own questions

SUGGESTED INSTRUCTIONAL STRATEGIES

Students interpret events in the world as either likely or unlikely to happen. They examine data to make sense of why some things happen instead of others and also to make predictions based on the frequency of events. At this level the vocabulary for describing the probability of the event becomes more refined.

- Have students place three red and three green Unifix cubes in a bag. Ask:
  - Is it possible that I'll pull out a blue?
  - Is it possible that I'll pull out a red?
  - What can you be certain of?
- Have students pull one cube out of the bag and chart or note its colour. Have them repeat this a number of times. Now ask:
  - What is likely to come out next?
  - If I change the combination of the cubes to five red and one green, will the outcome be different?
  - What if we increased the number of cubes? Discuss how the outcomes have changed. Ask:
  - What other variables might affect the outcome?

SUGGESTED ASSESSMENT STRATEGIES

As students conduct simple probability experiments to explain outcomes, they can demonstrate their ability to make sense of events. In assessing student progress, consider their ability to reason logically about why specific outcomes can or cannot occur, and their ability to communicate their reasoning.

Observe

- Can students identify an outcome as possible, impossible, certain, or uncertain?
- Can students compare outcomes as equally likely, more likely, or less likely?

Collect

- Have students record their experiences (e.g., how they designed and conducted experiments) in their math journal and explain their findings. Have them present their findings to small groups or the class.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- Division
- In All Probability: Investigations in Probability and Statistics
- Interactions 4–6
- Intermediate Probability Jobcards
- Probability
- The Problem Solver 4: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 4
- Underwater World Module Notes

Video

- Mathematics: What Are You Teaching My Child?

Software

- DataWonder! The Organizing, Graphing and Reporting Tool
- Turtle Math Set

Games/Manipulatives

- D.I.M.E. Probability Pack A
- D.I.M.E. Probability Pack B

PRESCRIBED LEARNING OUTCOMES

It is expected that students will demonstrate a number sense for whole numbers, from 0 to 100 000, and will explore proper fractions and decimal fractions.

It is expected that students will:

- demonstrate concretely and pictorially an understanding of place value from hundredths
- read and write numerals to a million
- read and write number words to 100 000
- use estimation strategies for quantities up to 100 000
- recognize, model, and describe multiples, factors, composites, and primes
- compare and/or order whole numbers
- represent and describe proper fractions concretely, pictorially, and symbolically
- demonstrate and describe equivalent fractions
- compare and order proper and decimal fractions to hundredths

SUGGESTED INSTRUCTIONAL STRATEGIES

Students who have a number sense generally use numbers flexibly and choose the most appropriate representation of a number for a given circumstance. Present a variety of puzzling and problem situations so that students can further investigate numbers and their relationships.

- Have each student hold a metric measuring tape or metre-stick. Discuss the relationship between a centimetre and a metre. Ask students to represent and locate various decimal number values on their tapes.
- Have students play Digit Roll in groups of four. The object is to write the greater number. Each player has five boxes. Taking turns, each player places a digit determined by the roll of a die into one of the five boxes. When each of the boxes has a digit, players read the numbers and decide who has the largest number. The winner rolls the die.
- Give students a pile of stones, straws, or sticks. Working with piles containing from 1 to 30 items, they must find out which size of pile can and cannot be sorted into several equal piles.

SUGGESTED ASSESSMENT STRATEGIES

Students demonstrate the extent of their number sense in almost every mathematical activity. As they learn new ideas or solve new problems, students enrich their thought processes and skills by building on previously developed ideas. Opportunities to explain and defend their ideas about numbers can deepen their understanding.

Observe

- Ask students to locate the position for a given decimal number on a measuring tape. Note the accuracy and efficiency of their responses. Invite them to explain their choices.
- Listen to students as they play Digit Roll. Use a checklist to note who is able to read numbers and create the largest values.
- Starting with a number such as 1.85, have students count up by 0.01s to 2.00. Listen for the correct change of place value from 1.89 to 1.90.

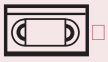
Collect

- Have students compare their estimates by exchanging their work with partners. Ask them to write journal entries about the processes they used and to give rationales for the strategies they used.

RECOMMENDED LEARNING RESOURCES

Print Materials

- 101 Winning Ways with Base Ten Grades 4–6
- Box Cars & One-Eyed Jacks
- Cooperative Problem Solving
- Discovery Kit - Fraction Pieces
- Fraction Blocks
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- Mental Math in the Middle Grades
- The Problem Solver 5: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 5



Video

- Mathematics: Assessing Understanding
- Mathematics: What Are You Teaching My Child?

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- Tima: Bars

Games/Manipulatives

- Fraction Stax

CD-ROM

- Adventures in Flight
- Math Made Fun

PRESCRIBED LEARNING OUTCOMES

It is expected that students will apply arithmetic operations on whole numbers and decimal fractions and illustrate the use of decimal fractions in solving problems.

It is expected that students will:

- add and subtract decimal fractions to hundredths concretely, pictorially, and symbolically
- estimate, mentally calculate, or compute and verify the product (three-digit by two-digit numbers) and quotient (three-digit by one-digit numbers) of the multiplication and division of whole numbers
- multiply and divide decimal fractions to hundredths concretely, pictorially, and symbolically using one-digit, whole number multipliers and divisors

SUGGESTED INSTRUCTIONAL STRATEGIES

In promoting the development of number sense, select activities that encourage students to develop their own techniques for finding answers, to consider alternate ways to solve problems, to consider the form their answers could take, and to share their reasoning with the class. Their consolidation of the basic arithmetic operations can be promoted by ensuring that students learn to calculate in a variety of ways, using written, mental, approximate, and electronic methods.

- Provide students with place-value mats. Using base-ten block cutouts, have students model the process of addition by representing each number on the mat, then combining and regrouping place-value cutouts as necessary. Record the number values as they proceed.
- Present the beginning of the following pattern:

  $4 \times 2 = 8$
  $4 \times 20 = 80$
  $4 \times 200 = 800$

  Have students continue the pattern and extend it to other examples. Have them play group or individual flashcard games to develop quick recall.
- Assign a project that requires students to compute all numbers in their heads, such as the cost of going on a field trip.
- Have students explore alternative ways to compute sums, differences, and the products of multiplication in their heads.
- Given that 1 is represented by a flat of base-ten blocks, create a model for 4.62. Challenge a group of students to divide the flat of blocks into three equal sets. Discuss the results. Ask: How many are in each set?

SUGGESTED ASSESSMENT STRATEGIES

As students work with basic operations, watch for evidence that they are able to estimate and verify their answers, as well as perform accurate calculations. Encourage them to assess their own work and to talk about the strategies they use.

Observe

- Provide students with an addition exercise. Have them represent it pictorially with base-ten blocks. Use photocopies of base-ten materials that students can cut out. Observe:
  - which students represent the first number correctly
  - which students add the blocks of the second number to the appropriate place-value columns
  - which students regroup those place values greater than nine
  - which students correctly record their procedures in numerical form as they proceed

Collect

- From the student projects, observe the degree to which students have used rounded-off numbers and estimated results.
- Have students complete a worksheet of questions and then have them check their answers using a calculator.

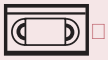
Question

- Interview students on the process they use in performing arithmetic operations.

RECOMMENDED LEARNING RESOURCES

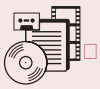
Print Materials

- 101 Winning Ways with Base Ten Grades 4–6
- Big Magic Number Puzzles
- Box Cars & One-Eyed Jacks
- Electrical Connections
- Finding Your Bearings
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Machine Shop
- Mathematics From Many Cultures
- Mental Math in the Middle Grades
- Problem Solving with Number Tiles
- The Problem Solver 5: Activities for Learning Problem-Solving Strategies
- Quest 2000: Exploring Mathematics Grade 5
- Space Trek



Video

- Mathematics: Assessing Understanding
- Mathematics: What Are You Teaching My Child?



Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

CD-ROM

- Adventures in Flight
- Math Made Fun

PRESCRIBED LEARNING OUTCOMES

It is expected that students will construct, extend, and summarize patterns, using rules, charts, mental mathematics, and calculators.

It is expected that students will:

- develop charts to record and reveal number patterns
- describe how a pattern grows using everyday language orally and in writing
- construct and expand patterns in two and three dimensions, concretely and pictorially
- generate number patterns within a problem-solving context
- predict and justify pattern extensions

SUGGESTED INSTRUCTIONAL STRATEGIES

Exploring patterns helps students develop mathematical literacy and instills in them an appreciation for the beauty of mathematics. In Grade 5, the emphasis shifts to general patterns, variables, and functions. By investigating patterns, students develop their mathematical abilities and hone their ability to describe, extend, create, analyse, and predict knowledgeably. Students need concrete and pictorial experiences to make connections and to build relationships between the real world and the symbolic nature of numbers.

- Have students work in small groups to stimulate conversations and discussion, and use counters to develop concrete patterns for doubling or tripling a given starting number. Have students design ways to record these patterns. Challenge them to find other examples of patterns.
- Have students use manipulatives such as tangrams, blocks, and grid paper to design a visual pattern of flips, slides, or tessellations to be presented to the class.
- Use the following activity to link math and science. Have students, working in small groups, measure and record temperature changes as ice cubes in water are gently warmed with a heat source. Gather data over a minimum of 15 minutes. As they record temperatures over time (e.g., every two minutes), have students predict what the next temperature will be. At the conclusion of the activity, have students make predictions on what would happen if the experiment were repeated with more or less ice.

SUGGESTED ASSESSMENT STRATEGIES

At the Grade 5 level, students broaden their pattern-recognition ability to include analysing, generalizing, and expressing more sophisticated patterns in a numerical form. This provides a foundation for their future understanding of more abstract algebraic concepts. They begin to develop an understanding of functions, which enables them to make predictions in real-life situations. Interviews and discussions can help you assess students' ability to use patterns, and can help them to clarify and consolidate their understanding.

Observe

- After students have designed a pattern, ask them to describe it in their own words. Observe whether they:
  - are able to describe a rule for their design
  - can create and describe multiple patterns

Collect

- Have students graph and present their time and temperature data as a pattern.
- Develop a rubric to assess the quality of the pattern developed by students.
- Have students write about their pattern rule and prediction in their learning logs or activity summary sheets.

RECOMMENDED LEARNING RESOURCES

Print Materials

- About Teaching Mathematics
- Box Cars & One-Eyed Jacks
- Budding Botanist
- Cooperative Problem Solving
- Detective Agency
- Electrical Connections
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- The Problem Solver 5: Activities for Learning Problem-Solving Strategies
- Problem Solving with Number Tiles
- Quest 2000: Exploring Mathematics Grade 5
- Writing Mathematics Grade 5

Video

- Mathematics: What Are You Teaching My Child?

CD-ROM

- Adventures in Flight

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use measurement concepts, appropriate tools, and the results of measurements to solve problems in real-life contexts.

It is expected that students will:

- recognize and explain the meaning of length, width, height, depth, thickness, perimeter, and circumference
- solve problems involving mass using grams, kilograms, and tonnes
- evaluate which units of measure would be most appropriate when selecting different measuring tools
- estimate and measure the area of irregular shapes by dividing them into parts

SUGGESTED INSTRUCTIONAL STRATEGIES

At the Grade 5 level, students should be consolidating their understanding of measurement as it relates to real-life situations. In presenting measurement activities, teachers need to provide a variety of measuring tools. For each activity, students learn to select an appropriate tool and unit for measuring. Observations and real measurements required for science activities can be incorporated easily into the mathematics activities.

- Have students estimate and measure the dimensions of objects in their environment (e.g., desks, books, balls, shadows, doors, body parts). Have students sketch and label (with correct units) the objects they have measured.
- Have students estimate the mass of common objects. Have students, working in groups, use balances to measure the mass of common objects. Have the groups order their objects according to their mass and express the mass in at least two different units.
- Have students construct, estimate, and measure the area of irregularly shaped objects, using geoboards, grid paper, and computer software.

SUGGESTED ASSESSMENT STRATEGIES

Students' ability to measure and to use measurement can be assessed while they are performing a variety of real-life activities. Teachers can help students clarify and communicate their understanding by asking questions about the processes and strategies that students are using.

Question

- When students make choices about measuring instruments and the units in which they express measurement, interview them (or have them write in learning logs or journals) about the reasons for their choices.
- Ask students to write in their learning logs about how they determined mass. Note the degree to which they communicate and their ability to present information about mass in more than one unit of measure (e.g., grams, kilograms).

Observe and Collect

- Set group performance tasks in which students model and share their solutions to area problems. You may wish to work with students to develop a checklist or rating scale for recording their performance. Let students know that they will be expected to provide pictorial and written evidence of their work for their portfolios or work collections, which should include descriptions of the processes they used.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Electrical Connections
- The Geoboard Portfolio
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Machine Shop
- Maneuvers with Rectangles
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Polyhedraville
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 5
- The Sky's The Limit
- Space Trek

Video

- Mathematics: What Are You Teaching My Child?

Software

- Turtle Math Set

CD-ROM

- Adventures in Flight

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- estimate and measure the perimeter of irregular shapes
- estimate and measure the effect on a rectangle's perimeter or area of changing one or more of its dimensions
- relate the perimeter and area of a rectangle, using manipulatives and diagrams
- relate the units cm^3 and mL
- estimate, measure, record, and order containers by volume using cm^3
- construct objects of a specific volume expressed in cm^3
- read and write SI notation for recording dates and time

SUGGESTED INSTRUCTIONAL STRATEGIES

- Have students, working in groups, use centimetre cubes, base-ten blocks, geoboards, or grid paper to construct rectangles. Have them express in their own words the perimeter and area of each rectangle. Challenge groups to construct as many different rectangles of a specified perimeter as they can. Record all shapes. Repeat the activity for a specified area.
- Have students bring in boxes of different sizes. Have them work individually or in groups to determine the volume of the boxes using centimetre cubes and base-ten blocks. Record estimates and measure data. Have the groups estimate the volume and capacity of tetrapaks in cm^3 and mL. Have groups deconstruct boxes into two-dimensional shapes to act as models for nets and scaled drawings on grid paper.

SUGGESTED ASSESSMENT STRATEGIES

Observe

- Have students write definitions of *perimeter* and *area* in their own words.
- Have students use computer software or manipulatives to model rectangles of specified dimensions.

Collect

- Have students collect and present information to show what happens to perimeter and area when length or width increases.
- Have students write about the strategy they used to determine the volume of food containers. Encourage them to speculate about other methods they could have used, and to compare the relative efficiency and accuracy of alternative methods.
- Challenge students to construct an object of a specified volume. Note which students are able to construct multiple objects of the same volume or to volunteer more than one approach or solution.
- Have students demonstrate their understanding of perimeter, area, or volume by creating and solving a problem. You may wish to require students to represent their thinking and problem solving in writing, in pictures, and in a construction.

Self-Assessment

- Have students work in small groups to create a self-assessment checklist they can use to monitor their understanding of perimeter, area, and volume.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Electrical Connections
- The Geoboard Portfolio
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Machine Shop
- Maneuvers with Rectangles
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Polyhedraville
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 5
- The Sky's The Limit
- Space Trek

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- Turtle Math Set

CD-ROM

- Adventures in Flight

Prescribed Learning Outcomes

It is expected that students will use the visualization of two-dimensional shapes and three-dimensional objects to solve problems related to spatial relation.

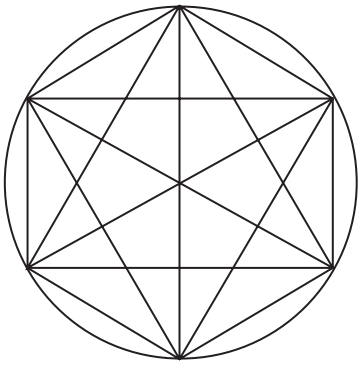
It is expected that students will:

- construct, analyse, and classify triangles according to their side measurements
- build, represent, and describe geometric objects and shapes
- classify and name polygons according to the number of their sides (e.g., 3, 4, 5, 6, 8)
- cover two-dimensional shapes with a set of tangram pieces
- complete the drawing of a three-dimensional object on grid paper given the front face
- determine experimentally the minimum information needed to draw or identify a given two-dimensional shape

Suggested Instructional Strategies

In Grade 5, we want students to consolidate their understanding of polygons and how they relate to three-dimensional objects. Many students at this age are still dependent on concrete referents and therefore require activities that use manipulatives to support and enrich their development of geometric and spatial sense. Modelling, mapping, and spatial experiences organized around physical models can help students discover, visualize, and represent geometric figures in the physical world.

- Have students work co-operatively to cut, sort, and glue three-, four-, five-, six-, and eight-sided figures from the following shape.



- Have students, cutting along straight lines only, find all the possible shapes with a given number of sides. Then have them group the shapes according to side lengths and explain their reasoning for the groupings.
- Provide students with sets of tangrams or cardboard cutouts. Challenge students to use the tangrams (or cutouts) to make other shapes, such as squares, trapezoids, or parallelograms. Then have them create the shapes, trace them, and exchange them with partners who then fill them in with the cutout shapes.
- Have students play a game in pairs in which each student hides a geometric shape and then describes it to his/her partner who must draw it from the description alone.

SUGGESTED ASSESSMENT STRATEGIES

Students reveal their understanding of shape and space as they manipulate, visualize, and talk about the objects around them. Their written and oral communications about their understanding of spatial relationships give students opportunities to use the language of mathematics, to explain their thinking, to use inductive reasoning, and to engage in divergent thinking.

Observe

- Collect sets of puzzles created by students. Observe students as they try to solve the puzzles their classmates have created.

Question

- Pose questions to students as they are working:
  - Why did you put these shapes together?
  - How are these similar and different?
  - How do the sides of these triangles vary?

  Record their rationales for classifying.

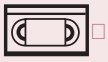
Collect

- Once students have been introduced to the names for various figures, they can play flashcard games in pairs or small groups to help memorize the names. They can then create their own records of their progress.
- Have students write a description of a shape, using the minimum number of criteria required to draw it. Look for the specific attributes described by students and record them using a checklist.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Detective Agency
- Discovery Kit - Double Tangrams
- The Geoboard Portfolio
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Polyhedraville
- Quest 2000: Exploring Mathematics Grade 5



Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- Making Connections Through Geometry: The Search Beneath the Sea
- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

CD-ROM

- Adventures in Flight

PRESCRIBED LEARNING OUTCOMES

It is expected that students will describe motion in terms of a slide, a turn, or a flip.

It is expected that students will:

- recognize motion as a slide (translation), a turn (rotation), or a flip (reflection)
- recognize tessellations created with regular and irregular shapes in the environment
- locate planes of symmetry by cutting solids
- use coordinates to describe the position of objects in two dimensions
- plot whole number, ordered number pairs in the first quadrant with intervals of 1, 2, 5, and 10
- identify a point in the first quadrant using ordered pairs
- cover a surface using one or more tessellating shapes
- create and identify tessellations using regular polygons
- identify regular polygons that can tessellate a plane

SUGGESTED INSTRUCTIONAL STRATEGIES

Students' experiences in geometry should show them that geometry has a dynamically important role in their environment. As students begin to examine how two-dimensional figures can be changed through movement, they begin to understand how this can be applied to tessellations. The physical world is rich with examples of how tessellations are applied in nature and areas such as computer animation and art.

- Have groups of students discuss the movement of athletes or objects such as birds in flight. Have them categorize the different ways in which they move and record these on paper, creating titles for each category. Have each group present its results. Summarize the activity by discussing that the basic terms for motion are *slide*, *turn*, and *flip*.
- Present students with a figure. Ask them, using geoboards, to copy it or create how it would look upside down or flipped over a line. Students can work in pairs and take turns doing similar activities. They can record their results on grid paper made of 5 x 5 dot patterns and then check their solutions by comparing their boards with their partners'.
- Have students use the nails on a geoboard as a coordinate grid to create figures from lists of ordered pairs of numbers.
- Have students create tessellations using regular polygons.

SUGGESTED ASSESSMENT STRATEGIES

Students demonstrate their understanding of transformations when they have opportunities to manipulate objects, to observe and record movement, and to talk about what they see and do. As students work with various shapes and constructions, consider their products and probe for evidence that they are developing spatial awareness.

Question

- As students discuss movement, ask questions such as: How are the movements different? How do we know all of these are "sliding-type" movements? Such discussions can help to refine students' use of language and conceptual knowledge before the introduction of formal language.

Observe

- Observe pairs of students using geoboards. Use a checklist or make notes to record the areas in which various students demonstrate skill or appear to have difficulty. For example:
  - Are the pictures the same size?
  - Do they move the right number of spaces in a slide?
  - Are the turns in the correct form and direction?

Collect

- Have each student monitor and verify his/her own understanding by recording and labelling one slide, one flip, and one turn on a grid sheet.
- Ask each student to create or find four examples of tessellating artwork and to include a written description of each. You may wish or require that two of these involve regular shapes and two of them involve irregular shapes.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Detective Agency
- Discovery Kit - Double Tangrams
- The Geoboard Portfolio
- Interactions 4–6
- Polyhedraville
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 5

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- TesselMania!
- Turtle Math Set
- Understanding Math

CD-ROM

- Adventures in Flight

PRESCRIBED LEARNING OUTCOMES

It is expected that students will develop and implement a plan for the collection, display, and analysis of data gathered from appropriate samples.

It is expected that students will:

- identify a question to generate appropriate data and predict results
- distinguish between a total population and a sample
- use a variety of methods to collect and record data
- create classifications and ranges for grouping data
- display data by hand or by computer in a variety of ways, including:
  - frequency diagrams
  - line plots
  - broken-line graphs
- evaluate the graphic presentation of the data to ensure the clear representation of the results
- discuss the reasonableness of the data and the results
- make inferences from the data to generate a conclusion

SUGGESTED INSTRUCTIONAL STRATEGIES

In Grade 5, the skills for analysing information in graph form are developed and practised within projects generated by the students themselves. Instruction should include sound reasoning and decision-making experiences with large sets of data. Graph building should be consolidated with students using several forms of organizing and displaying data, but their analysis of process results and their predictions will require guidance.

- Have students brainstorm topics of personal interest in order to develop questions for investigation. For example:
  - global warming (investigate average world temperatures)
  - sports activities (investigate the most common sports or leisure activity done by students)

  The data can be collected using student-developed survey forms, interviews, and so on. Have students summarize their information using tables, tallies, lists, and so on. Have them use one or more of the following techniques to group or classify data: age ranges (0 to 4, 5 to 9, 10 to 14); identifiable characteristics (age, size, shape); natural breaks (clusters of data).

SUGGESTED ASSESSMENT STRATEGIES

Classroom experiences build on students' natural abilities to use data to solve problems in everyday situations. As students collect, summarize, and display data, watch for evidence of logical and critical reasoning and systematic approaches.

Collect

- Develop a set of criteria with students for them to use in developing their graphs. For example:
  - Are the axes clearly labelled?
  - Are the increments consistently used?
  - Is the plotting accurate?
  - Is the presentation clear and appealing?

Question

- Conduct a class discussion about the effects of the following on students' conclusions and interpretations:
  - sample size (small versus large)
  - method of classification
  - type of graph

  Note which students are able to apply and extend what they have learned and which students appear to need additional modelling and guided practice. At the end of the discussion, you may wish to have students write a short summary or list in their learning logs or journals of the things they have learned.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Baseball Math
- Box Cars & One-Eyed Jacks
- Budding Botanist
- Electrical Connections
- Finding Your Bearings
- In All Probability: Investigations in Probability and Statistics
- Interactions 4–6
- Intermediate Probability Jobcards
- Machine Shop
- Mathematics From Many Cultures
- Out of this World
- Quest 2000: Exploring Mathematics Grade 5
- The Sky's The Limit
- Space Trek
- Writing Mathematics Grade 5

Video

- Mathematics: What Are You Teaching My Child?

Software

- The Cruncher
- DataWonder! The Organizing, Graphing and Reporting Tool
- Turtle Math Set

Games/Manipulatives

- D.I.M.E. Probability Pack A
- D.I.M.E. Probability Pack B

PRESCRIBED LEARNING OUTCOMES

It is expected that students will predict outcomes, conduct experiments, and communicate the probability of single events.

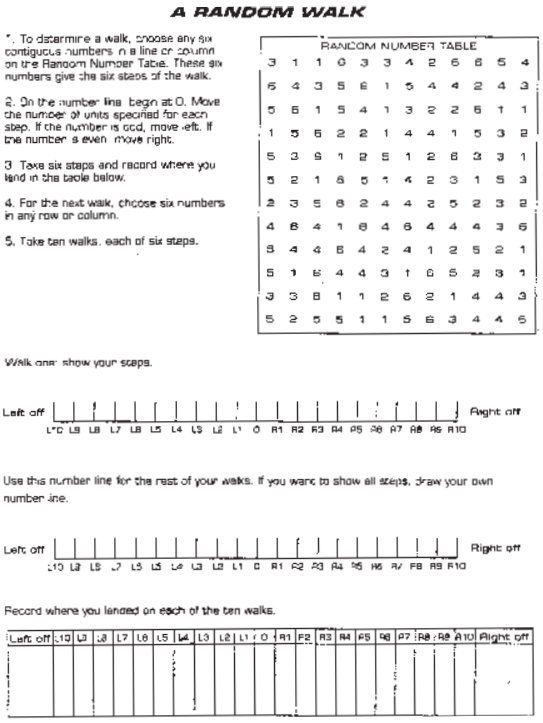
It is expected that students will:

- list all possible outcomes of an event
- explain events using the vocabulary of probability:
  - *best/worst*
  - *probable/improbable*
  - *never/less likely/equally likely*
  - *likely/more likely/always*
- conduct probability experiments and explain the results using the vocabulary of probability
- conduct probability experiments to demonstrate that results are not influenced by factors such as the age, experience, or skill of the participant

SUGGESTED INSTRUCTIONAL STRATEGIES

Chance and uncertainty are of interest to students because they apply to the games that they play. Activity-based co-operative grouping works well as an instructional approach. Through their own experiences, students build critical-thinking skills that help them make decisions in situations of uncertainty.

- Have students work in groups to develop a chart or table of possible outcomes from throwing a pair of dice and adding the result. Have several groups throw a set of dice several times and record the results as sums of the dice. Discuss the differences in the results between the groups and how these differences relate to probability.
- Have students play the game A Random Walk.



A RANDOM WALK

1. To determine a walk, choose any six contiguous numbers in a line or column on the Random Number Table. These six numbers give the six steps of the walk.

2. On the number line, begin at 0. Move the number of units specified for each step. If the number is odd, move left. If the number is even, move right.

3. Take six steps and record where you land in the table below.

4. For the next walk, choose six numbers in any row or column.

5. Take ten walks, each of six steps.

RANDOM NUMBER TABLE

3	1	1	0	3	3	4	2	6	6	5	4
6	4	3	5	6	1	5	4	4	2	4	3
5	6	1	5	4	1	3	2	2	6	1	1
1	5	6	2	2	1	4	4	1	5	3	2
5	3	6	1	2	5	1	2	6	3	3	1
5	2	1	6	5	1	4	2	3	1	5	3
2	3	5	6	2	4	4	2	5	2	3	2
4	6	4	1	6	4	6	4	4	4	3	6
6	4	4	6	4	2	4	1	2	5	2	1
5	1	6	4	4	3	1	6	5	2	3	1
3	3	6	1	1	2	6	2	1	4	4	3
5	2	5	5	1	1	5	6	3	4	4	5

Walk one: show your steps.

Left off L10 L9 L8 L7 L6 L5 L4 L3 L2 L1 0 R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 Right off

Use this number line for the rest of your walks. If you want to show all steps, draw your own number line.

Left off L10 L9 L8 L7 L6 L5 L4 L3 L2 L1 0 R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 Right off

Record where you landed on each of the ten walks.

Left off	L10	L9	L8	L7	L6	L5	L4	L3	L2	L1	0	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	Right off

SUGGESTED ASSESSMENT STRATEGIES

The assessment of students' understanding of chance and probability at this level should focus on students' developing awareness, and their ability to talk and write about these concepts and to demonstrate their understanding through simple experiments or games of chance. As their understanding of chance and probability grows, students should participate in these activities with confidence and enthusiasm.

Observe

- How do students approach activities involving chance?
- What strategies do they use when conducting probability experiments?
- To what degree can they describe and present to others their understanding of chance?

Question

- Have students describe in their own words how A Random Walk is played. Their descriptions might be oral or written as a learning log entry.
- Interview students to determine their understanding of the factors that may influence outcomes:
  - To what degree can students describe these factors?

RECOMMENDED LEARNING RESOURCES

Print Materials

- Baseball Math
- Box Cars & One-Eyed Jacks
- In All Probability: Investigations in Probability and Statistics
- Interactions 4–6
- Intermediate Probability Jobcards
- Quest 2000: Exploring Mathematics Grade 5
- Writing Mathematics Grade 5

Video

- Mathematics: What Are You Teaching My Child?

Software

- The Cruncher
- DataWonder! The Organizing, Graphing and Reporting Tool
- Turtle Math Set

Games/Manipulatives

- D.I.M.E. Probability Pack A
- D.I.M.E. Probability Pack B

PRESCRIBED LEARNING OUTCOMES

It is expected that students will develop a number sense for common fractions and explore number sense for whole numbers.

It is expected that students will:

- read and write numerals greater than a million
- use estimation strategies for quantities up to a million
- distinguish relationships among multiples, factors, composites, and primes
- represent positive powers of numbers concretely, pictorially, and symbolically
- use power, base, and exponent to represent repeated multiplication
- explain the meaning of *integers* by extending their counting to numbers less than 0
- identify practical applications of integers
- read and write numbers to thousandths
- demonstrate and explain the meaning of *improper fractions* and *mixed numbers* (positive) concretely and pictorially
- demonstrate and describe equivalent mixed numbers and improper fractions concretely and pictorially
- compare and order improper fractions, mixed numbers, and decimal fractions to thousandths
- demonstrate and explain the meaning of *ratio* concretely and pictorially
- demonstrate and explain the meaning of *percentage* concretely and pictorially

SUGGESTED INSTRUCTIONAL STRATEGIES

Students who have a number sense pay attention to the meaning of numbers and number operations and make realistic estimates for the results of computation. Students need many opportunities to estimate and check their solutions. Having to justify their mathematical thinking can help them develop their ability to communicate mathematically. The integration of mathematics with social studies topics (e.g., mapping, population distribution) provides students with real data for their work.

- Read students the story *The King's Chessboard* by David Birch. Have students explore pattern by predicting the amounts that will result if one used a doubling pattern to cover the chessboard with grains of rice: one grain in the first square, two grains in the second square, four grains in the third square, and so on. Have them estimate the total number of grains and then find a way to calculate the result.
- For this activity use pattern blocks. Ask students: If the shaded area is $\frac{1}{3}$ cm^3, what is the value of the whole design? Have students make a design with a value of eleven-thirds and have them explain how they determined the value of each piece.

- Give pairs of students maps of the world and select five countries for the class to study. Have each pair of students estimate the area of each country using the map's scale and a centimetre grid. When they have finished, have them collect the class data and calculate an average area for each country. Have students consult the social studies text or another reference to check whether the average determined by the class or an estimate determined by one of the pairs is closest to the actual area of each country. Encourage students to express the area in various ways (3 400 000 km^2 or 3.4 million km^2).

SUGGESTED ASSESSMENT STRATEGIES

Students reveal their number sense as they engage in increasingly complex mathematical situations. In order to assess their thinking and the strategies they are using, present situations that require them to estimate and explain the reasonableness of their answers. Their ability to communicate their thinking will reveal how well they understand why various kinds of numbers occur and the relationships among the different ways to represent numbers.

Observe

- Are students confident when using large numbers?
- What different methods do they use when calculating?
- How do they react when comparing their initial estimates to the results they get from calculating?

Question

- Observe and note students' responses during conversations. Ask:
  - How did you arrive at your estimate?
  - Did anyone use a different strategy?
  - How would you go about finding a country about the same size as _____?

Collect

- To what degree is the student able to represent fractions concretely and pictorially? Does the rationale given for her/his presentation make sense?
- Use a worksheet to check students' ability to convert between decimal numbers and equivalent fractions.

RECOMMENDED LEARNING RESOURCES

Print Materials

- 101 Winning Ways with Base Ten Grades 4–6
- Box Cars & One-Eyed Jacks
- Constructing Ideas About Fractions, Decimals & Percents
- Fraction Blocks
- Interactions 4-6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Mathematics From Many Cultures
- Mental Math in the Middle Grades
- Quest 2000: Exploring Mathematics Grade 6

Video

- Mathematics: Assessing Understanding
- Mathematics: What Are You Teaching My Child?

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- Tima: Bars

Games/Manipulatives

- Fraction Stax

CD-ROM

- Math Made Fun

PRESCRIBED LEARNING OUTCOMES

It is expected that students will apply arithmetic operations on whole numbers and decimal fractions in solving problems.

It is expected that students will:

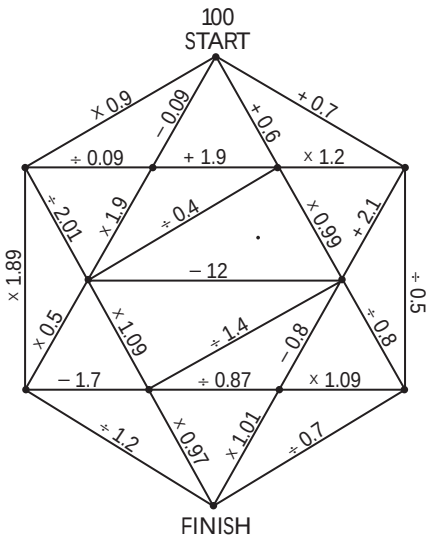
- estimate the solutions to calculations involving whole numbers and decimal fractions

SUGGESTED INSTRUCTIONAL STRATEGIES

Students' number sense and estimation skills complement their abilities to compute accurately using appropriate strategies and tools such as mental computation, paper-and-pencil calculations, calculators, and computers. Allowing students the freedom to create and solve their own problems by using strategies that are intuitively obvious to them helps them feel more comfortable with the problem-solving process.

- Have students play the Maze game. Give each student a copy of the maze and a calculator. Each student begins by keying in 100 on the calculator. The goal is to choose a path that will give the player the largest value at the finish. Movement is unidirectional: players may not retrace a path or move upwards in the maze. For each segment moved along the maze, students key in the operation.

Maze
Playing Board



- Ask students to figure out a quick way to compute an answer mentally and to explain why their shortcut works.

SUGGESTED ASSESSMENT STRATEGIES

Students need to be able to perform arithmetic operations relatively quickly and accurately, and to estimate solutions in a variety of situations. In some cases, you can assess their facility with calculations as part of problem-solving activities; in others, you may wish to devise specific activities or prompts to check on their development.

Observe and Question

- After students have played the Maze game, ask them to write in their learning logs using prompts such as:
  - I was surprised when _____.
  - My strategy for winning _____.
- Bring students together as a class or in small groups to talk about what they noticed and wrote about. For example, you might probe to determine whether they have generalized concepts such as:
  - Dividing by a decimal fraction smaller than 1.0 results in a larger quotient.
  - The product resulting when one of the factors is less than 10 is smaller than the largest factor.

  During their discussions, note:
  - which students verbalize their strategies
  - to what degree the strategies are comprehensible, sophisticated, and effective
- Students who hesitate to share their ideas in a whole-group setting can be assessed by having them explain ideas to a partner or to the teacher in an interview.

RECOMMENDED LEARNING RESOURCES

Print Materials

- 101 Winning Ways with Base Ten Grades 4–6
- Big Magic Number Puzzles
- Constructing Ideas About Fractions, Decimals & Percents
- Box Cars & One-Eyed Jacks
- Electrical Connections
- Finding Your Bearings
- Interactions 4-6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Machine Shop
- Mathematics From Many Cultures
- Mental Math in the Middle Grades
- Problem Solving with Number Tiles
- Quest 2000: Exploring Mathematics Grade 6

Video

- Dive in to Math
- Mathematics: Assessing Understanding
- Mathematics: What Are You Teaching My Child?

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- Mathville

CD-ROM

- Math Made Fun

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use relationships to summarize, generalize, and extend patterns.

It is expected that students will:

- construct a visual representation of a pattern to clarify relationships and to verify predictions
- summarize a relationship using everyday language in spoken or written form
- create expressions and rules to describe patterns and relationships (e.g., area, perimeter, volume)
- interpolate number values from a given graph
- predict pattern relationships

SUGGESTED INSTRUCTIONAL STRATEGIES

The study of patterns and relationships, while still involving visual representations, begins to be more formalized at this level, as numerical or algebraic rules are established to describe patterns and relationships. However, students should also study patterns as a link to understanding mathematics and their environment. Many Grade 6 students will benefit from the visual and tactile support that manipulatives provide.

- Have students study problems that are rich in pattern development. For example:
  - How many squares in a checkerboard?
  - How many handshakes would result in a group of seven people if everyone shakes everyone else's hand?
  - How many blocks are there in the tenth step of a step design?

PEOPLE	1	2	3	4	5	? →	10
HANDSHAKES	0	1	3	6	10	? →	?

- Use the following questions to help students reach a conclusion for the problem related to handshakes, which is described above:
  - What is the next number in the people row?
  - How are the number of handshakes increasing?
  - What is the difference between each column?
  - If there were ten people rather than seven, how many handshakes would there be?
  - What can we do to the numbers to predict the number of handshakes?

SUGGESTED ASSESSMENT STRATEGIES

As students engage in problem-solving activities, encourage them to talk or write about the strategies and processes they use. Determine how they generate and use mathematical rules, and to what extent they recognize how a pattern grows and how it can be predicted.

Observe

- Examine students' work for evidence of the strategies they used to solve a particular problem:
  - Have they developed a chart or picture sequence to show an understanding of the problem? How effective or appropriate is it?
  - Have they created a number sequence to show the pattern? To what extent is it logical and helpful?

Self-Assessment

- Have students assess their own work by explaining:
  - the problem in their own words (understanding)
  - how they worked to solve the problem (process)
  - the relationship they discovered (solution)
  - how the problem or the strategies they used could be applied in a new situation

Collect

- Have each student develop a collection of the problems they solved over a period of time. Have them include problems from other subject areas and from outside school. Review the collections to assess growth and changes in students' understanding and use of patterns. You may wish to have students review these collections and write a summary in their math journals listing things that they notice about their work.

RECOMMENDED LEARNING RESOURCES

Print Materials

- About Teaching Mathematics
- Discovery Kit - Double Tangrams
- Games in the Teaching of Mathematics
- Historical Connections in Mathematics
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Linking Mathematics and Language: Practical Classroom Activities
- Math Bridges: Everyday Math for Home and School
- A Mathematical Pandora's Box
- Mathematical Reasoning Through Verbal Analysis: Book 2
- Problem Of The Day
- Quest 2000: Exploring Mathematics Grade 6
- Using Calculators Is Easy: Complete Guide For The Classroom

Video

- Focus on Fractals

Software

- The Logic Box
- Mathville

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use informal and concrete representations of equality and operations on equality to solve problems.

It is expected that students will:

- generalize a pattern by substituting numbers into a frame and compare the results to the original pattern
- demonstrate the meaning and the preservation of equality using objects, models, and diagrams
- graph ordered pairs in the first quadrant, analyse results, and generalize relationships
- solve one-variable equations with whole number coefficients and solutions using informal techniques

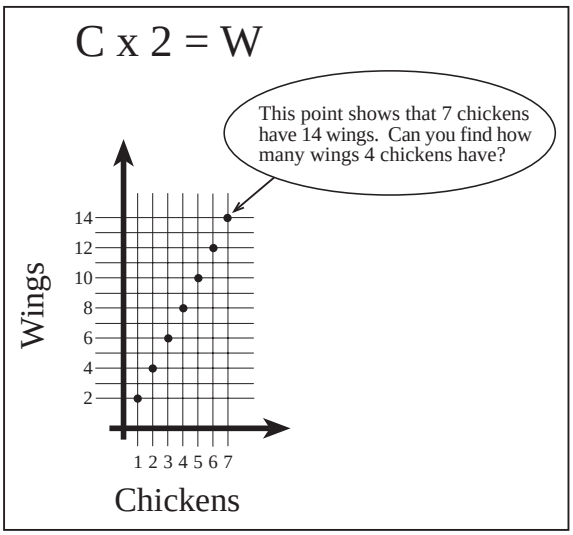
SUGGESTED INSTRUCTIONAL STRATEGIES

Students' previous experiences with patterns allowed them to generalize patterns with words and then symbols. At the Grade 6 level, the idea of variables evolves in a natural way and becomes another way to describe patterns in the real world. Experiences with geometrical interpretations and graphing help students understand how to use generalizations to find particular values for variables.

- Present students with problems similar to the following: The relationship between chickens and wings is that for every chicken there are two wings. Represent chickens with C, wings with W. Create a table to show the relationship for increasing numbers of chickens.

C	W
0	0
1	2
2	4
3	6
.	.
.	.
.	.

Copy and extend the table and ask students to graph it. Discuss how students can make predictions beyond the points on their graph.



SUGGESTED ASSESSMENT STRATEGIES

Students demonstrate their understanding of patterns and relations as they work with various representations of the same information, including charts, graphs, and equations. By asking them to predict beyond what is given or modelled, to generalize, and to suggest situations in which similar patterns exist, you can assess the extent to which students understand patterns and relations.

Collect

- Review students' graphs and charts for evidence of precision:
  - Can they label the axes and plot the points?
  - Can they extend the pattern and table further?
- Ask students to create an example of their own that illustrates similar skills, ideas, and relationships to those in the chicken example. Collect their work and review the charts and graphs for accuracy and to see whether their charts and graphs are similar.

Observe

- Observe students as they investigate problems such as the following:
  - How could you change the equation $7 = 3 + 4$ and still keep it true or equal?

  Listen to students' descriptions of methods for solving the equation. Note shareable strategies such as guess and test, use of manipulatives, inverse properties, and checking with calculators.

RECOMMENDED LEARNING RESOURCES

Print Materials

- About Teaching Mathematics
- Games in the Teaching of Mathematics
- Historical Connections in Mathematics
- Linking Mathematics and Language: Practical Classroom Activities
- Math Bridges: Everyday Math for Home and School
- A Mathematical Pandora's Box
- Mathematical Reasoning Through Verbal Analysis: Book 2
- Problem Of The Day
- Quest 2000: Exploring Mathematics Grade 6
- Using Calculators Is Easy: Complete Guide For The Classroom

Video

- Focus on Fractals
- Mathematics: What Are You Teaching My Child?

Software

- The Logic Box
- Mathville
- Understanding Math

PRESCRIBED LEARNING OUTCOMES

It is expected that students will be able to solve problems involving perimeter, area, surface area, volume, and angle measurement.

It is expected that students will:

- convert between commonly used SI units of length, mass, and capacity
- develop, verify, and use rules or expressions to determine the perimeter of polygons
- develop, verify, and use rules or expressions to determine the area of rectangles
- estimate, measure, and then calculate the surface area of right rectangular prisms (without using a formula)
- discover, generalize, and use rules to determine the volume of right rectangular prisms

SUGGESTED INSTRUCTIONAL STRATEGIES

Classroom experiences should continue to involve students in hands-on measurement activities, which provide them with the opportunity to communicate about various measurements and to discuss the need for, and importance of, estimating and using standard units. In this way, students consolidate their understanding of measurement.

- Have students, working in groups, use centimetre cubes, beakers, and scales. Have them drop a specific number of centimetre cubes into a beaker filled with a set amount of water. They should measure the rise in millilitres of water. Then, using a scale, they should compare the weight of the displaced water in grams with the volume of the water displaced. Have them build a table to show several measures and discuss relationships. As a project, students could integrate mathematics with science by first estimating and then measuring the volume and mass of rocks or other objects.
- Have students do group projects that involve finding the surface area of cardboard boxes. Have them explore how the surface area of the boxes relates to the volume inside. What shape provides the smallest surface area for any given volume?

SUGGESTED ASSESSMENT STRATEGIES

Students reveal and consolidate their understanding of perimeter, area, surface area, volume, and angles when they engage in problem-solving activities that involve the measurement of concrete objects. Their ability to select appropriate tools and units of measure, depending on the degree of accuracy required, can be assessed as they solve problems.

Observe

- Observe students to determine to what extent they are measuring volume and mass appropriately and accurately.
- Listen to students' group presentations to see if students have understood their measurements. Can they identify relationships between surface area and volume or area and perimeter? Examine students' products for accurate measurement and the use of correct units.

Collect

- Collect students' charts or patterns and have them write summaries of their conclusions on the patterns noted. Look for their understanding of equality among grams, millilitres, and cubic centimetres.
- Collect their answers to a set of questions used to practise converting units mentally (e.g., 12 cm = 120 mm).

Self-Assessment

- Ask students to assess their activities. You may wish to provide a series of questions to guide their self-assessment:
  - How accurate are my measures?
  - Why are the millilitres and grams not identical?
  - Why are some measures larger or smaller?
  - Have I summarized my work clearly?

RECOMMENDED LEARNING RESOURCES

Print Materials

- Constructing Ideas About Fractions, Decimals & Percents
- Electrical Connections
- The Geoboard Portfolio
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Machine Shop
- Maneuvers with Rectangles
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Quest 2000: Exploring Mathematics Grade 6
- The Sky's The Limit

Video

- Mathematics: What Are You Teaching My Child?
- Paper Engineering

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- determine the volume of an object by measuring the amount of liquid displaced by that object (cm^3 or mL)
- recognize angles as being more than 90°, equal to 90°, less than 90°, or greater than 180°
- estimate and measure angles using a circular protractor
- draw and sketch an angle in which the degrees in the angle are specified
- classify given angles as acute, right, obtuse, straight, or reflex
- identify and compare examples of angles in the environment

SUGGESTED INSTRUCTIONAL STRATEGIES

- Have students work in groups of three and use a length of string to create angles of various sizes. Discuss the types of angles, and have students classify groups of angles. Ask: Is this more than 90° or less? How many degrees might this be?
- Have students cut out pictures from magazines and trace and extend lines that make angles within the pictures. Then have students measure and label examples of each type of angle using these pictures.
- Integrate computer artwork with mathematics by challenging students to draw their own pictures. Then have them label and measure the angles within their drawings.

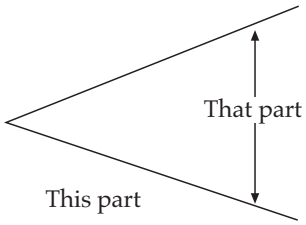
SUGGESTED ASSESSMENT STRATEGIES

Observe

- When groups are working to create and measure angles, note the extent to which students arrive at appropriate approximations.

Collect

- Collect and review students' collections of magazine pictures with angles marked to check on their skill in measuring and classifying angles.
- Provide opportunities for students to share their computer artwork in which angles have been labelled and measured. Prompt them by asking:
  - Where is the angle?
  - Which part are you measuring?
  - Is this part a bigger angle than that part?



- Ask each student to investigate and report on a situation in the working world in which angles are measured. They should include an explanation of the purpose of and the method used for the measurements.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Constructing Ideas About Fractions, Decimals & Percents
- Electrical Connections
- The Geoboard Portfolio
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Machine Shop
- Maneuvers with Rectangles
- Mathematics From Many Cultures
- Measure It! Grades 4–6
- Quest 2000: Exploring Mathematics Grade 6
- The Sky's The Limit

Video

- Mathematics: What Are You Teaching My Child?
- Paper Engineering

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area, and Volume

Prescribed Learning Outcomes

It is expected that students will use visualization and symmetry to solve problems involving classification and sketching.

It is expected that students will:

- classify triangles according to the measurement of their angles
- sort quadrilaterals and regular polygons according to the number of lines of symmetry
- recognize and describe optical illusions
- reproduce a given geometric drawing on grid paper
- sketch three-dimensional solids and skeletons with or without grids

Suggested Instructional Strategies

Students who develop spatial sense are better able to interpret and appreciate the shapes that surround us. Interior design, architecture, the building trades, gardening, and other projects related to the home all require spatial sense. To build spatial understanding, students need to engage in activities in which they visualize, draw, measure, construct, and explore relationships among shapes.

- Have students create as many different triangles as possible on a geoboard. Have them work with a partner to record the different (incongruent) triangles on grid paper. Have each pair of students keep one triangle on their geoboard. Then have the class work as a group to sort these triangles by the measurement of their angles:
  - triangles with all angles less than 90°
  - right-angle triangles
  - triangles with one angle greater than 90°
- Reproduce several of the student-generated triangles on a worksheet. Have students use protractors to measure and label the angles. Have them compare and discuss any discrepancies in their measurements and remeasure when they are unsure which is the most reasonable measurement. Ask students to find the sum of the three angles for each triangle. Ask: Is there a pattern? Have students remeasure the angles in the triangles, making their measurements as accurate as possible so that they add up to 180°.

SUGGESTED ASSESSMENT STRATEGIES

Geometry is the study of objects, motions, and relationships in a spatial environment. Through the development of higher-order thinking skills, students can link the physical world to abstract representations. Their ability to make these connections can be assessed through their ability to plan approaches to problem exploration and by their confidence and ability to explain and verify solutions.

Observe

- Observe and note students' rationales for classifying triangles. Have they avoided recording congruent triangles? How many different triangles have they generated?

Collect

- Ask students to obtain (or make) examples of, and use their own words to write explanations or descriptions of, one or more of the following:
  - optical illusion
  - three-dimensional solids
  - lines of symmetry
- Have each student work with a partner to write directions about using a protractor. Their directions should include how to draw angles of different sizes. Students should include drawings if they help clarify the directions. Brainstorm a list of vocabulary that might be useful such as *protractor*, *angle*, and *acute*.
- You may wish to work with students to develop a checklist or rating scale that specifies criteria for assessing their work (e.g., clarity, completeness). Alternatively, students could check on their instructions by exchanging them with another pair who would then follow the instructions and report on the results.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Constructing Ideas About Fractions, Decimals & Percents
- Discovery Kit - Double Tangrams
- The Geoboard Portfolio
- Interactions 4–6
- Kids 'n' Calculators: How to Use the Calculator as a Teaching Tool
- Making Connections Through Geometry: The Search Beneath the Sea
- Measure It! Grades 4–6
- Quest 2000: Exploring Mathematics Grade 6

Video

- Mathematics: What Are You Teaching My Child?
- Paper Engineering

Multimedia

- Making Connections Through Geometry: The Search Beneath the Sea
- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

PRESCRIBED LEARNING OUTCOMES

It is expected that students will create patterns and designs that incorporate symmetry, translations, tessellations, and reflections.

It is expected that students will:

- create, analyse, and describe designs using translations (slides) and reflections (flips)
- draw designs using ordered pairs in the first quadrant of the coordinate grid, together with slide and flip images

SUGGESTED INSTRUCTIONAL STRATEGIES

Although many Grade 6 students are capable of dealing with abstractions, the main focus of these activities is still on concrete and pictorial experiences. Through the use of models, students develop the concepts necessary to make abstractions and generalizations. The study of tessellations is particularly good for developing transformation concepts.

- Display examples of tessellation designs in the classroom (wallpaper, Escher posters, fabric samples). Have students, working in small groups, move from sample to sample and, for each sample, make a prediction about the transformations required to create the pattern. Discuss which strategies were used to design the pattern.
- Have students create their own tessellating shapes by modifying a basic geometric shape, such as the square.
- Have students explore more complex translations using tessellation software.

SUGGESTED ASSESSMENT STRATEGIES

Students reveal their understanding and ability to apply transformations when they respond to challenging design problems. As they create constructions and pictorial representations and explain their work, they provide evidence of their knowledge and skills.

Collect

- Analyse and respond to student designs in terms of the degree of sophistication shown. For example:
  - the number of sides modified
  - the complexity of the transformation (slide, flip, combination of movements)
  - design elements, use of colour and detail

Peer Assessment

- After students have created a design, have each present his/her work to a partner. Encourage partners to ask questions and offer positive comments about the designs. Remind them to use correct spatial terms to help clarify their meaning. Then have students write descriptions of their partners' designs in their learning logs, using a framework such as the following:
  - Description of my partner's design: _____.
  - Ways my partner's design and mine were the same: _____.
  - Ways in which they were different: _____.
  - Things I learned from listening to and interviewing my partner: _____.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Discovery Kit - Double Tangrams
- The Geoboard Portfolio
- Interactions 4–6
- The Puzzling World of Tangrams and Pentominoes
- Quest 2000: Exploring Mathematics Grade 6

Video

- Mathematics: What Are You Teaching My Child?
- Paper Engineering

Multimedia

- Making Connections Through Geometry: The Search Beneath the Sea
- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- 3-D Images
- Geometry Inventor
- TesselMania!
- Understanding Math

PRESCRIBED LEARNING OUTCOMES

It is expected that students will develop and implement a plan for the collection, display, and analysis of data gathered from appropriate samples.

It is expected that students will:

- formulate a key question from a problem-solving context
- identify appropriate data sources (first-hand, second-hand, a combination of first- and second-hand)
- select and justify appropriate methods of collecting data (designing and using structured questionnaires, experiments, observations, and electronic networks)
- select and justify the choice of an appropriate population sample to use to answer a particular question
- discuss how the data collected are affected by the nature of the sample, the method of collection, the sample size, and biases
- display data by hand or by computer in a variety of ways, including histograms, double bar graphs, and stem and leaf plots
- read and interpret graphs that are provided
- describe the general distribution of data:
  - smallest and largest value
  - frequency (which occurs most often/least often)
  - value in the middle
  - patterns
- analyse sets of data to make comparisons and test predictions

SUGGESTED INSTRUCTIONAL STRATEGIES

Students increase and practise skills for analysing information in graph form by doing projects of their own. They can review many mathematical ideas and relate mathematics to the real world as they consolidate and extend their understanding of statistical notions.

- Provide students with a variety of graphs (from the National Council of Teachers of Mathematics *Standards Document on Probability and Statistics*, from newspapers, from textbooks) and have them work in groups to discuss potential biases. Brainstorm questions such as:
  - Was first- or second-hand information used?
  - Who do you think was surveyed?
  - How might the information be different if another group was surveyed?
  - How many people were surveyed?
  - Was that number of people enough? Why or why not?
  - Was the group of people surveyed a representative group?
  - What predictions would you make here?

  Groups could make their predictions to the whole class.
- Collect data from students on their food preferences. Have them redraw the information into double-bar-graph format using boys and girls as the variable and write a paragraph on comparisons and possible predictions.
- Have students brainstorm problems that might require the use of data collection or surveys for solutions. Look for issues that can be viewed using two criteria (e.g., number of people and number of preferences).
- Have students do a class survey that involves three different segments of the class. Have them create simple graphs to compare differences in results and then have them discuss sampling bias.

SUGGESTED ASSESSMENT STRATEGIES

Research projects provide students with real experiences in dealing with information and data first-hand. Students can develop and extend their skills and knowledge through activities that they plan and carry out independently or as part of a group. After they have had opportunities to practise the skills involved in formulating a question, planning a statistical investigation, and collecting and reporting data, have students make predictions about other populations. Students can then design and complete research projects as a final assessment activity.

Collect

- Collect student graphs and look for their use of:
  - correct naming of axes
  - appropriate intervals for the data
  - proximity of columns in bar graphs
- Have students write about the data with regard to *smallest*, *largest*, *most often*, *most common*, *middle*, and *potential patterns*.

Question

- Interview groups, pairs, or individual students regarding their project. Ask them whether the population sample that they have used for their project will answer the question accurately.

Self-Assessment

- Have students complete a self-assessment of their projects. You might wish to help them develop a checklist with a set of criteria they can use. For example:
  - question: what is appropriate, inappropriate?
  - sample
  - data collection method
  - recording of data
  - computations
  - choice of data display
  - creation of display/graph

RECOMMENDED LEARNING RESOURCES

Print Materials

- Baseball Math
- Box Cars & One-Eyed Jacks
- Constructing Ideas About Fractions, Decimals & Percents
- Electrical Connections
- Finding Your Bearings
- In All Probability: Investigations in Probability and Statistics
- Interactions 4–6
- Intermediate Probability Jobcards
- Machine Shop
- Mathematics From Many Cultures
- Out of this World
- Quest 2000: Exploring Mathematics Grade 6
- The Sky's The Limit

Video

- Dive in to Math
- Mathematics: What Are You Teaching My Child?

Software

- The Cruncher
- DataWonder! The Organizing, Graphing and Reporting Tool

Games/Manipulatives

- D.I.M.E. Probability Pack A
- D.I.M.E. Probability Pack B

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use numbers to communicate the probability of single events from experiments and models.

It is expected that students will:

- distinguish between the experimental and theoretical probability of single events
- using various polyhedrons as dice, identify the relationship between the number of faces and the probability of a single event
- calculate theoretical probability using numbers between 0 and 1
- demonstrate that different outcomes may occur when the same experiment is repeated
- compare experimental results with theoretical results

SUGGESTED INSTRUCTIONAL STRATEGIES

An understanding of probability and the related area of statistics is essential to being an informed citizen. Students must actively participate in experiments involving probability to develop an understanding of the relationship between the numerical expression of a probability and the events that give rise to those numbers. Such investigations should include a variety of realistic problems.

- Have students make, bring, or use materials that could be used for probability experiments in class (e.g., dice, spinners, coins). Initially, students should have a device that will produce a multiple of 50 so that they can easily compare results expressed in fractions. Have students run 50 events with their material and record the results in chart form. Have them repeat this with another 50 trials and record the results in a double-stem-leaf frequency graph. Discuss their results and rationale. After discussing theoretical and experimental probability with students, look again at their results. Have them compare their theoretical and experimental results and explain the differences.

SUGGESTED ASSESSMENT STRATEGIES

Students' approach to and their perseverance in completing probability experiments can reveal a great deal about their prior knowledge and their understanding. As students increase their knowledge about probability, look for evidence that they seek ways to apply and extend what they have learned. Their understanding of probability and chance can contribute to their development as critical thinkers.

Observe

- As students are running the events, make notes about what they say will happen the most, the least, and how often. Look for fair experimentation.
- Have groups share their results. Ensure that students have recorded their results correctly in table form.

Question

- Ask questions about how often certain events occurred. Have students give experimental probability of the events.

Collect

- Look for accurate theoretical probability in students' work.
- When reading students' rationales about the probability figures, look to see if their comments have changed to ones that are mathematically based on statistics.
- Ask students to look outside school to find applications of what they have learned about probability (e.g., lotteries, card or dice games, weather forecasts, earthquake risks, fish survival). Have them describe the situations in words, numbers, and (where appropriate) charts or graphs.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- Interactions 4–6
- Intermediate Probability Jobcards
- Quest 2000: Exploring Mathematics Grade 6

Video

- Mathematics: What Are You Teaching My Child?

Games/Manipulatives

- D.I.M.E. Probability Pack A
- D.I.M.E. Probability Pack B

PRESCRIBED LEARNING OUTCOMES

It is expected that students will demonstrate a number sense for decimal fractions and integers (including whole numbers).

It is expected that students will:

- recognize, model, identify, and describe common multiples, common factors, least common multiples, greatest common factors, and prime factorization
- write whole numbers as expanded numerals using powers of 10 and in scientific notation
- use divisibility rules to determine whether a number is divisible by 2, 3, 4, 5, 6, 8, 9, 10, or 11
- read and write numbers to any number of decimal places
- recognize and illustrate that all fractions and mixed numbers can be represented in decimal form (including terminating and repeating decimal fractions)
- convert from terminating decimal fractions to common fractions and from single-digit repeating decimal numbers to common fractions using patterns
- demonstrate concretely and pictorially that the sum of opposite integers is 0
- represent integers in a variety of concrete, pictorial, and symbolic ways
- compare and order integers

SUGGESTED INSTRUCTIONAL STRATEGIES

Personal encounters with meaningful number situations help students recognize the use of rational numbers to describe quantities. Rational numbers and proportions are an important focus in the Grade 7 curriculum. Instruction that builds on students' natural language and their informal notions of fractions, ratios, decimals, percents, and proportions enables them to become quantitatively literate.

- Give pairs of students two calculators each and review how to use the addition constant feature to skip count by tens. Point out that the numbers that appear in the display are multiples of ten. Then have one student use a calculator to skip count by fours, while the other uses her/his calculator to skip count by fives. Invite predictions by asking: Would the two calculators ever show the same number? If so, which numbers? Have the pairs use the calculators to check their predictions. Encourage them to look for a number pattern. Ask why this pattern occurs. (The common multiples of 4, 5, and 10 are 20, 40, and 60.) Have students record repeated addition and multiples on a number line. Extend the investigation to the common multiples of other pairs of numbers. Encourage students to look for patterns.
- Simulation: the stock market. Choose ten stocks that students are familiar with from the Toronto Stock Exchange. Give students a fictional amount of money to invest and have them track the movement of the stocks each day. Then, by converting to decimal fractions, have them calculate how much money they have made or lost.

SUGGESTED ASSESSMENT STRATEGIES

Students demonstrate their growing number sense through the ways that they use and interpret numbers, their growing sense of accuracy when computing, their ability to detect errors, and their common-sense approach to using numbers. Assess students' facility with using decimal fractions and integers by observing and questioning them as they work, as well as by collecting written evidence.

Observe

- When students are explaining their predictions about common multiples, note which students:
  - guess that some numbers will be the same without giving reasons
  - predict that the product of the two numbers will be a common multiple
  - predict that multiples of this product will also be common multiples

Question

- Discuss with small groups or individuals:
  - the strategies they used to convert information on common fractions to decimal numbers
  - whether they noticed any patterns or developed any shortcuts
  - the decisions they made regarding repeating decimals

Collect

- Examine students' work to determine their level of understanding and their ability to apply their knowledge.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- Constructing Ideas About Fractions, Decimals & Percents
- Fraction Blocks
- Interactions 7
- Mathematics From Many Cultures
- Mathpower Seven
- Mental Math in Junior High
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary
- Soar with Integers: A Complete Teaching & Learning Resource

Video

- Mathematics: What Are You Teaching My Child?

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- Tima: Bars

CD-ROM

- Math Made Fun
- Pre-Algebra Math Blaster Mystery: The Great Brain Robbery

PRESCRIBED LEARNING OUTCOMES

It is expected that students will apply arithmetic operations on decimal fractions and integers and illustrate their use in solving problems.

It is expected that students will:

- use patterns, manipulatives, and diagrams to demonstrate the concepts of multiplication and division by decimal fractions
- use estimation strategies to predict or assess the reasonableness of their calculations
- add, subtract, multiply, and divide decimal fractions (using technology for more than two-digit divisors or multipliers)
- demonstrate an understanding of the order of operations, using paper and pencil and a calculator
- add, subtract, multiply, and divide integers concretely, pictorially, and symbolically

It is expected that students will illustrate the use of ratios, rates, percentages, and decimal numbers in solving problems.

It is expected that students will:

- estimate and calculate percentages
- distinguish between *rate* and *ratio*
- explain and demonstrate the use of proportion in solving problems
- mentally convert proper fractions, decimal fractions, and percentages from one to another to facilitate the solution of problems

SUGGESTED INSTRUCTIONAL STRATEGIES

Students with a number sense will choose or invent methods for solving problems that reflect their own understanding of the relationships between numbers and operations, and will seek the most efficient ways to represent the problems and possible solutions. Using technology can help students deal with the complexity of the numbers they may encounter in problem situations. Yet concrete computations are still important when dealing with concepts such as *integers, ratios,* and *percentages.*

- Using base-ten blocks with a flat representing 1, teach students to understand how $0.2 \times 0.3 = 0.06$. Students need to see that a part of a part is smaller than both beginning parts. Have students show simple multiplication using the base-ten blocks.
- Model the use of positive and negative charges to calculate with integers. Provide students with two colour chips. For example: To calculate $+4 - -2 =$ _____, students place four "plus" chips in front of them (e.g., ++++). Because there are no "negative" chips present, they cannot remove negative 2. Therefore they must insert two neutral (represented by two "plus" chips and two "negative" chips) (++++ −−++). Now students can take away two "negative"chips, leaving a value of +6 (e.g., ++++++), therefore $+4 - -2 = +6$. Have students draw models to solve this problem.
- Have students practise calculating percentages mentally. For example, if 1 percent of 200 is 2, what else can you determine? Extend the concept to include: 100 percent of 124 is 124. Extend the oral exercise to look at combinations of 1 percent, 10 percent, and 100 percent. For example, knowing that 10 percent of 400 is 40 and 1 percent of 400 is 4, how much is 23 percent of 400?

SUGGESTED ASSESSMENT STRATEGIES

Monitor students' skills and application of arithmetic operations involving decimal fractions and integers by collecting and analysing a variety of problem-solving activities as well as by asking students to explain the processes they use. In addition to assessing their accuracy of computation, watch for their use of logic, a systematic approach to problem solving, and their ability to make connections.

Observe

- Observe students as they use models to do multiplication. Can students develop a generalization from the patterns to solve decimal placement in multiplication?
- Analyse students' representations of integers with electrical charges and other formats. Do they accurately represent the process?

Collect

- Collect patterns and statements written by students:
  - Are they making simple connections from 1 percent to 10 percent?
  - Have they followed and extended patterns?
  - Have they given examples?
- Collect student-generated transformation pathways. Are the procedures systematic and the rules clear?

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- Constructing Ideas About Fractions, Decimals & Percents
- Electrical Connections
- Interactions 7
- Machine Shop
- Mathematics From Many Cultures
- Mathpower Seven
- Mental Math in Junior High
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary
- Numbers and Patterns: Investigating Rate, Ratio, and Proportion
- Soar with Integers: A Complete Teaching & Learning Resource

Video

- Dive in to Math
- Mathematics: What Are You Teaching My Child?

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- Mathville

CD-ROM

- Math Made Fun
- Pre-Algebra Math Blaster Mystery: The Great Brain Robbery

PRESCRIBED LEARNING OUTCOMES

It is expected that students will express patterns in terms of variables and use expressions containing variables to make predictions.

It is expected that students will:

- create formulas for finding area, perimeter, and volume
- predict and justify the *n*th value of a number pattern

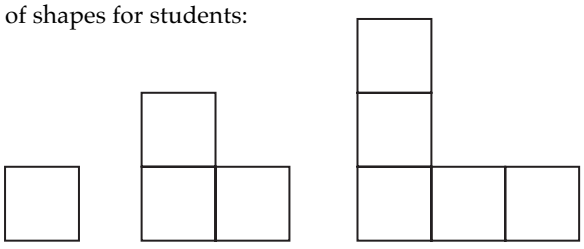
SUGGESTED INSTRUCTIONAL STRATEGIES

Patterns help bring order, cohesion, and predictability to seemingly random events and situations. Students can investigate a variety of problems that show how pattern helps them understand functional relationships. Recognizing these patterns and functional relationships allows students to predict results and make generalizations that are not possible when students only memorize formulas.

- Review/introduce standard units of measure (e.g., cm for linear measure, cm^2 for area, cm^3 for volume). Have students bring in food containers, such as candy boxes, cereal boxes, and tetrapaks. Have them use centimetre cubes to determine the volume of the different containers. Record the class data on a table.

Object	Length	Width	Height	Volume
Cereal Box				

  As a class, have students discuss and remeasure any disputed measurements to find solutions that all agree on. Then have them examine the table to generate the formula for volume. Two possibilities: Build one layer of cubes and add the number of layers it would take to fill one of the containers, or build one row of cubes along the length, width, and height and use this information to compute the total number of cubes required to fill the container.
- Using colour tiles, model the following sequence of shapes for students:



  Have students build the next three shapes and record the number of tiles in each construction. Then ask them to look at the pattern and predict how many tiles might be in the twentieth figure. Discuss ways to find out.

SUGGESTED ASSESSMENT STRATEGIES

While students are working on problems, look for evidence that they are able to recognize patterns and functional relationships and use their understanding to make predictions and generalizations. Some of this evidence should come from students' oral and written explanations as well as from their calculations and constructions.

Observe

- Ask students to determine the volume of a container, write down their solutions, and then tell how they arrived at their answers. Look for logic or a system in their solutions. Probe to find out if they are able to generalize their solutions to other structures and to recognize how their solution relates to other methods of determining volume.
- Note how different students describe growth patterns during a whole-class discussion. Look for pattern recognition, the logic of student predictions, and students' inclination to generalize or make connections. After many growth-pattern investigations in which students extend a pattern and find a formula to describe it, ask students to complete a learning log entry: What I learned about growth patterns. Note which students are able to offer clear, logical explanations that include generalizations and connections beyond the immediate activity.

RECOMMENDED LEARNING RESOURCES

Print Materials

- About Teaching Mathematics
- Discovery Kit - Double Tangrams
- Games in the Teaching of Mathematics
- Historical Connections in Mathematics
- Interactions 7
- Linking Mathematics and Language: Practical Classroom Activities
- A Mathematical Pandora's Box
- Mathematical Reasoning Through Verbal Analysis: Book 2
- Mathpower Seven
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary
- Problem Of The Day

Video

- Focus on Fractals
- Mathematics: What Are You Teaching My Child?

Software

- The Logic Box
- Mathville

PRESCRIBED LEARNING OUTCOMES

It is expected that students will use variables and equations to express, summarize, and apply relationships as problem-solving tools in a restricted range of contexts.

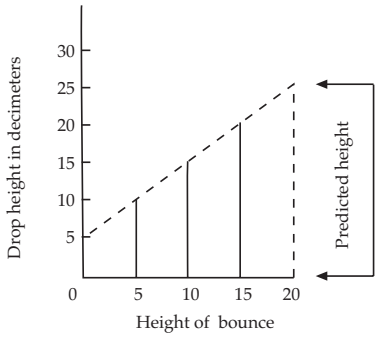
It is expected that students will:

- generalize a pattern arising from a problem-solving context using an open number sentence with appropriate variables
- substitute number variables and compare the results to concrete models and tables
- write expressions involving variables using standard mathematical conventions
- analyse relations graphically to discover how changes in one quantity may affect others
- graph relations, analyse results, and draw conclusions
- solve and verify simple linear equations using a variety of techniques
- use patterns and relationships to represent and solve problems by translating everyday language into mathematical symbols and vice versa
- explain how to solve simple problems using informal algebraic methods

SUGGESTED INSTRUCTIONAL STRATEGIES

Experiences with geometrical interpretations and graphing of different patterns can allow students to form a basis from which to study algebra. Integrating a science investigation (measuring rates of growth or change) and measurement topics (area, perimeter, volume) as the context for coordinate graphing can help students make connections between algebra and real-world applications.

- Graphs can be used to predict specific future events. For example, a graph of heights for the first bounce of a ball as it is dropped from successively higher points may be used to make a prediction for how high the ball will bounce.



The two variables for the bouncing-ball graph are the height from which the ball was dropped and the height of the first bounce. Once students have been instructed in the basic techniques for assembling coordinate graphs, have them create their own graphs. Almost any source of data can be displayed on a coordinate graph. Other areas to explore: circumference/area, area/volume, rate of temperature change when melting ice, and so on.

SUGGESTED ASSESSMENT STRATEGIES

As students explore interesting problems, applications, and situations that involve variables and functions, they develop an understanding of how algebra can be used to model situations and how the algebraic model is related to other models or representations. In assessing students' ability to use variables and equations, focus on their representations (in words, mathematical symbols, and graphs) and their explanations.

Question

- When students are presenting graphs to the class, ask them to write a list of questions to prompt class discussion. Consider the extent to which the questions allow their classmates to understand the relationships and to generalize in order to predict beyond the information provided on the graph.

Collect

- Provide students with a representation in one form (e.g., a graph) and ask them to develop at least two alternative ways of expressing the relationship (e.g., number sentences, equation, concrete model, table). Look for logic, the accurate use of symbols, and efficiency in their translations.
- Provide students with a simple linear equation and ask them to write an entry in their learning logs telling everything that the equation conveys to them: What does it mean? How do they know? Challenge students to take a simple equation (e.g., 2 + 3 = 5) and make it longer in a variety of ways, but still equal.
- Give students a simple problem. Ask them to develop (a) a graphic representation that would help clarify the problem and (b) an equation that they could use to solve the problem. Have them include a list of the decisions they made as they worked and the rationale for each.

RECOMMENDED LEARNING RESOURCES

Print Materials

- About Teaching Mathematics
- Games in the Teaching of Mathematics
- Historical Connections in Mathematics
- Interactions 7
- Linking Mathematics and Language: Practical Classroom Activities
- A Mathematical Pandora's Box
- Mathematical Reasoning Through Verbal Analysis: Book 2
- Mathpower Seven
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary
- Problem Of The Day

Video

- Focus on Fractals
- Mathematics: What Are You Teaching My Child?

Software

- The Logic Box
- Mathville
- Understanding Math

PRESCRIBED LEARNING OUTCOMES

It is expected that students will solve problems involving the properties of circles and their relationships to angles and time zones.

It is expected that students will:

- measure the diameter, radius, and circumference of circles and generalize the relationships
- solve problems involving circles (radius, diameter, and circumference)
- explain how time zones are determined
- determine time in various regions of the world

SUGGESTED INSTRUCTIONAL STRATEGIES

Measurement experiences can show the usefulness of mathematics in everyday life. As students continue to actively explore measurement, they can develop a variety of procedures and formulas for determining measures.

- Have students use a bicycle wheel to investigate the relationship between diameter and circumference:
  - If my wheel is 70 cm in diameter, how far can I go in one revolution? How about in ten revolutions?
  - The radius on little brother's bike is 20 cm. How far will he go in one revolution?
- Have students measure the diameter and circumference of five or six common round objects found in the room or at home and record the data on a chart.
- Have students use a calculator to calculate circumference divided by diameter to two decimal places. Discuss the relationships/patterns found. Ask:
  - Can you make a statement about a circle and how it relates to diameter?
  - Check your generalization by using a piece of string cut to the length of the circumference. Is the string a little more than three times the length of the diameter?
- Use a time-zone map (e.g., from the phone book) to generate a discussion of different world time zones. To investigate the different segments for each time zone, ask: Why is there more space for each zone for countries near the equator than there is for countries in the north? Relate the discussion to circles and angles with the north and south poles as centres.

SUGGESTED ASSESSMENT STRATEGIES

Students can best demonstrate their knowledge by applying it to new situations and real-life problems. In this way they develop more efficient procedures and formulas for determining circle measurements, which they can then extend to the properties of other polygons. Their ability to reason deductively and to relate mathematical ideas to each other further illustrates their understanding.

Observe

- As students engage in the tasks, note:
  - the extent of student involvement
  - the amount of time students persevere with each task
  - the degree of independence students show in completing each task
  - students' inclination to extend or repeat the task
  - the consistency and accuracy of students' measurements and calculations

Question

- Invite students to explain the processes and strategies they use as they work. You may wish to provide a set of learning log prompts such as:
  - What pieces of information did you focus on to start with?
  - How did you decide what method or strategy to try first?
  - How many different ways did you try to solve the problem? Which one worked best for you? In what other ways could you have solved this?
  - How did you check your work? How else could you have confirmed that your result was accurate?
  - Where else could you apply or use the strategies and processes you used today?

Record

- To record information, use observation charts, checklists with specific criteria, teacher-selected problem sets, and student math journals/ portfolios.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Constructing Ideas About Fractions, Decimals & Percents
- Electrical Connections
- The Geoboard Portfolio
- Interactions 7
- Machine Shop
- Mathematics From Many Cultures
- Mathpower Seven
- Maths Workshop
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary
- The Sky's The Limit

Video

- Mathematics: What Are You Teaching My Child?
- Paper Engineering

Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- research and report how measurement instruments are used in the community
- design and construct rectangles, given either or both the perimeter and the area (in whole numbers)
- demonstrate and generalize that many rectangles are possible for a given perimeter or a given area

SUGGESTED INSTRUCTIONAL STRATEGIES

The practical uses of measurement are investigated in the context of the instruments that help us in our daily lives. Exploring both common and more sophisticated measurement tools will allow students to appreciate the importance of measurement in mathematics. Looking at the relationships between the area and the perimeter in rectangles further helps students understand their world.

- Use the classroom as a context for solving problems. For example: Our eight classroom tables need to be rearranged to allow groups to meet and work together. One person can sit on each end of a table and two can sit on each side. What is the best way to rearrange the tables so that we can maximize the seating space? What are all the possible arrangements for the tables, and how many can sit in each arrangement? If we need seating for only 24 people, what are all the possible arrangements? Students may use tiles, graph paper, or blocks to explore this problem. Ask them to explain how they have solved similar problems in the past.

SUGGESTED ASSESSMENT STRATEGIES

In making connections with the real world, students consider what they already know and then look for new applications of their learning. By asking questions, you can elicit what students already know and have them demonstrate what they have gained from the learning. This kind of activity encourages students to make connections and to see the relevance of new learning.

Observe and Collect

- When looking at students' projects, focus on:
  - what the student knows before the project begins
  - the level of detail that students incorporate into the project
  - how well students connect the mathematical topics to their projects
  - students' ability to demonstrate what they have learned from the project
  - students' level of interest and enthusiasm

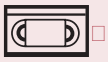
Assessment Tools

- The following tools are useful in assessing student progress:
  - criterion-based checklists or rating scales (developed with students)
  - student journals
  - conferences/interviews

RECOMMENDED LEARNING RESOURCES

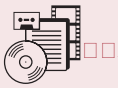
Print Materials

- Constructing Ideas About Fractions, Decimals & Percents
- Electrical Connections
- The Geoboard Portfolio
- Interactions 7
- Machine Shop
- Mathematics From Many Cultures
- Mathpower Seven
- Maths Workshop
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary
- The Sky's The Limit



Video

- Mathematics: What Are You Teaching My Child?
- Paper Engineering



Multimedia

- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Prescribed Learning Outcomes

It is expected that students will link angle measurements to the properties of parallel lines.

It is expected that students will:

- measure and classify pairs of angles, complementary angles (90°), or supplementary angles (180°)
- identify and name pairs of angles pertaining to parallel lines and transversals, including:
  - corresponding angles
  - vertically opposite angles
  - interior angles on the same side of the transversal
  - exterior angles on the same side of the transversal
  - interior alternate angles
- describe the relationships between the pairs of angles pertaining to parallel lines and transversals
- use mathematical reasoning to determine the measures of angles in a diagram
- perform calculations with angle measures
- construct angle bisectors and perpendicular bisectors
- explain in more than one way why the sum of the measures of the angles of a triangle is 180°

Suggested Instructional Strategies

Geometric models can provide a perspective that can make an abstract representation of the world more easily understood. As students construct, draw, measure, compare, and classify figures, they develop more meaningful definitions for relationships among figures and are more able to use these ideas to develop informal conjectures. Students should be challenged to analyse their thinking about lines and angles and justify their explanations.

- Have students create tessellations using trapezoids, triangles, or parallelograms (pattern blocks). Have them discuss the segments and angles created in their figures. Ask them to present information to answer the following questions:
  - Which lines are parallel?
  - Which lines are transversals?
  - Which angles are interior alternate or supplementary pairs?
  - Which angles are complimentary or supplementary?
  - Which lines are interior or exterior?

  Have students transfer the tessellations to paper and label them. Have them use the pattern blocks to identify the equal angles. Ask them to measure only one angle, and then, using previous knowledge, ask them to discuss how to calculate the remaining angles. Have them label all the angle sizes in their tessellations.
- Have students integrate art with geometry by creating designs by bisecting angles and lines.
- To introduce angles and prompt discussion, have students stand in a circle with one person in the middle. Pull three strings from the middle to serve as radii. Have students pass the strings around the circle to create different angles.

SUGGESTED ASSESSMENT STRATEGIES

Geometry is the study of objects, motions, and relationships in a spatial environment. As students become more skilled at connecting the physical world to abstract representations, they demonstrate how well they have developed spatial awareness. As they work and talk together, students can share ideas, draw conclusions, and analyse their activities.

Observe

- Find pictures in magazines that show a variety of angles and lines. Have students present and describe the pictures to the class. Record the extent to which students use vocabulary appropriately.
- Have groups of students model with metre-sticks the variety of angles and intersecting lines. Observe the students to ensure that they use correct definitions and examples.

Collect

- Collect student line designs that use bisection. Look for accuracy in their construction process.
- Give the students a worksheet that contains randomly mixed pictures of angles and names. Have students complete the worksheet by matching the appropriate pairs.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Constructing Ideas About Fractions, Decimals & Percents
- Discovery Kit - Double Tangrams
- The Geoboard Portfolio
- Interactions 7
- Mathematics From Many Cultures
- Mathpower Seven
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary

Video

- The Manor House Mystery
- Mathematics: What Are You Teaching My Child?

Multimedia

- Making Connections Through Geometry: The Search Beneath the Sea
- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- 3-D Images

PRESCRIBED LEARNING OUTCOMES

It is expected that students will create and analyse patterns and designs using congruence, symmetry, translation, rotation, and reflection.

It is expected that students will:

- create, analyse, and describe designs using rotations (turns), reflections (flips), and translations (slides)
- use informal concepts of congruence to describe images after rotations (turns), reflections (flips), and translations (slides)
- draw designs using ordered pairs in all four quadrants of the coordinate grid, together with slide and flip images
- connect reflections with lines and planes of symmetry

SUGGESTED INSTRUCTIONAL STRATEGIES

Through working with transformations, students learn the concepts of *congruence* and *similarity.* Observing and learning to draw and construct two- and three-dimensional figures in various positions also helps them develop spatial sense. Computer software can allow students to construct shapes on a screen and then view them from a new perspective. The use of other manipulatives, such as Mira boards or geoboards, can also help with the visualization process.

- Have students create designs on isometric dot paper that illustrate the three transformations, and include written descriptions of the transformations used to create the designs.
- Have students work in pairs on a computer with drawing software. Have the first student draw a figure. Have the second student then use the software tools to perform transformations on the image, such as flip, rotate, or cut and paste to another space. Then have students reverse roles. Finally, ask students to identify a line of symmetry with their image or create one if one does not exist.
- Have students study modern artists or M.C. Escher and create their own designs using similar techniques.

SUGGESTED ASSESSMENT STRATEGIES

As students engage in experiences that involve transformations, they make predictions about what may happen given a particular action. They become more able to explain their results and can begin to formulate a number of different conjectures related to these constructions. Focus assessment on students' ability to create transformations to communicate the process.

Question

- Prompt a discussion of the transformations that students used by asking questions such as:
  - Tell me about your design.
  - What part of your design repeats?
  - Who used slides?
  - If you used a slide instead of a flip, what would your design look like?

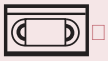
Collect

- Review students' designs and written explanations for evidence that they understand and are systematic in the way they apply transformations. Note the extent to which their language is precise and their explanations efficient.
- At the completion of the unit, have students evaluate their collections of transformation drawings using preset criteria, such as:
  - were they able to identify transformations in art
  - whether all three types of transformations have been included in their work

RECOMMENDED LEARNING RESOURCES

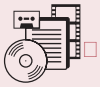
Print Materials

- Discovery Kit - Double Tangrams
- The Geoboard Portfolio
- Interactions 7
- Mathpower Seven
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary
- Slides, Flips and Turns



Video

- The Manor House Mystery
- Mathematics: What Are You Teaching My Child?
- Paper Engineering



Multimedia

- Making Connections Through Geometry: The Search Beneath the Sea
- The Zoo Design Challenge: Exploring Perimeter, Area And Volume

Software

- 3-D Images
- Geometry Inventor
- Understanding Math

PRESCRIBED LEARNING OUTCOMES

It is expected that students will develop and implement a plan for the collection, display, and analysis of data, using measures of variability and central tendency.

It is expected that students will:

- formulate questions that explore whether or not a relationship exists in a real-world context
- select and justify appropriate methods of collecting data (designing and using questionnaires, interviews, experiments, research)
- display data by hand or by computer in a variety of ways, including circle graphs
- read and interpret graphs that are provided
- determine measures of central tendency for a set of data:
  - mode
  - median
  - mean
- determine measures of the distribution of a set of data:
  - range
  - extremes, gaps, and clusters
  - quartiles
- interpolate from data to make predictions

SUGGESTED INSTRUCTIONAL STRATEGIES

Statistics allow us to make a summary of what we know of the world and to make inferences about things we do not know. Young students pose questions based on their immediate environment. Students' investigations expand to include community and global issues. Often the questions they wish to investigate are raised in social studies and science contexts. Statistics are also used frequently in the world of sports.

- Have students formulate and implement a plan to pursue a question of interest to them, such as:
  - How does height relate to jumping ability?
  - Does your pet prefer dry or moist food?
- Discuss appropriate ways to collect and display data for different kinds of questions. Their plan must include a method for collecting data (e.g., experimental measurement, library research, survey forms), for organizing and graphing the data, and for drawing conclusions or raising further questions from the investigation.
- Using students' graphs, discuss with the class what information can be derived from them such as mean, median, mode, and range.

SUGGESTED ASSESSMENT STRATEGIES

When students gather their own data, they are familiar with and interested in the information. They develop a greater understanding of what it means to organize and summarize data and are then better able to draw conclusions and to make predictions for new contexts.

Collect

- After a whole-class discussion, ask students to write to reflect on their reasoning, including information about revisions they may have made. Look for evidence of logical reasoning. For example, how does the student explain why the average is between the highest and lowest values?
- After students have had opportunities to display information in a variety of ways, ask them to make a list of the decisions that need to be made when summarizing and displaying data.
- Work with the class to develop task specifications and a checklist or rating scale that specifies criteria for scoring their investigations.

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- Constructing Ideas About Fractions, Decimals & Percents
- Electrical Connections
- Interactions 7
- Junior High Probability Jobcards
- Machine Shop
- Mathematics From Many Cultures
- Mathpower Seven
- Maths Workshop
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary
- Out of this World
- The Sky's The Limit

Video

- Mathematics: What Are You Teaching My Child?

Software

- The Cruncher
- Statistics Workshop

Games/Manipulatives

- D.I.M.E. Probability Pack A
- D.I.M.E. Probability Pack B

PRESCRIBED LEARNING OUTCOMES

It is expected that students will create and solve problems using probability.

It is expected that students will:

- use a table to identify all possible outcomes of two independent events
- use simulation or experimentation to solve probability problems
- create and solve problems using the definition of probability as favourable outcomes over total outcomes

SUGGESTED INSTRUCTIONAL STRATEGIES

The nature of probability encourages a systematic and logical approach to problem solving. Probability is an area that can motivate students' interest, stimulate their mathematical thinking, and give them practice to reinforce number skills. When they conduct probability experiments using real data, they are challenged to make sense of situations in which they cannot be totally sure of the outcome. This further develops their critical-thinking skills.

- Have students determine the number of possible outcomes that can occur by rolling two dice. Record the possible outcomes on a chart, defining that a roll of 1, 3 is a different outcome than 3, 1.

Possible Totals	2	3	4	5	6	7	8	9	10	11	12
			2,2 3,1 1,3								
Total Ways			3								

Once all possible outcomes have been determined, have students calculate the probability of rolling a 7. Have them calculate the probability of rolling each of the other sums. Ask them to add up the probabilities for all of the sums. What is the total probability? Have them explain why this makes sense.

- Pose similar problems in which students need to determine probability. (e.g., Using a deck of cards, what is the chance of pulling out a 5, or a heart?)

SUGGESTED ASSESSMENT STRATEGIES

Understanding about probability grows over time and is deepened by experience and discussion. Ongoing observations and evidence of students' ability to use probability should be collected in the context of problem-solving activities. Students develop an appreciation of the power of simulation and experimentation by comparing experimental results to the mathematically derived probabilities. Throughout their experimentation and simulation, students make hypotheses, test predictions, and refine their theories on the basis of new information.

Collect

- Examine the charts that students develop for evidence of understanding, logical reasoning, and clarity:
  - Did students find all 36 possible dice outcomes?
  - Do they communicate their understanding by using terms such as *favourable* or *total outcomes*?

RECOMMENDED LEARNING RESOURCES

Print Materials

- Box Cars & One-Eyed Jacks
- Dealing with Data: Probability and Sampling
- Interactions 7
- Junior High Probability Jobcards
- Mathpower Seven
- Minds on Math 7
- Nelson Canadian School Mathematics Dictionary

Software

- The Cruncher

Games/Manipulatives

- D.I.M.E. Probability Pack A
- D.I.M.E. Probability Pack B

APPENDICES

Mathematics K to 7

Appendix A

Prescribed Learning Outcomes
Mathematics K to 7

NUMBER (NUMBER CONCEPTS)

Students use numbers to describe quantities. They represent numbers in multiple ways.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Recognize, describe, and use numbers from 0 to 100 in a variety of familiar settings • count orally by 1s, 2s, 5s, and 10s to 100 • estimate and count objects in a set (0 to 50) and compare estimates to the actual number • recognize, build, compare, and order sets of objects (0 to 50) using both comparative and numerical terms • read number words up to 10 • explore, represent, and describe numbers up to 50 in a variety of ways • use a calculator or computer to explore and represent numbers up to 100 • demonstrate and explain orally an understanding of "half" as part of a whole	Develop a number sense for whole numbers from 0 to 1000 and common fractions to tenths • estimate and then count an increased number of objects in a set, and compare the estimate with the actual number • skip count forward and backward by 2s, 5s, 10s, 25s, and 100s to 1000, using starting points that are multiples; and skip count forward using random starting points • recognize, build, compare, and order sets that contain 0 to 1000 elements • round numbers to nearest 10 and 100 • read and write number words to 100 and numerals to 1000 • use ordinal numbers to 100 • explore, represent, and describe numbers to 1000 in a variety of ways, including the use of calculators and computers • demonstrate place-value concepts concretely and pictorially to give meaning to numbers 0 to 1000 • demonstrate whether a number is even or odd • recognize and explain whether a number is divisible by 2, 5, or 10 • demonstrate and explain in a variety of ways an understanding of halves, thirds, fourths, fifths, and tenths as part of a region or a set	Demonstrate a number sense for whole numbers from 0 to 10 000 and for proper fractions • estimate and then count the number of objects in a set (0 to 1000), and compare the estimate with the actual number • use skip counting (both forward and backward) to support their understanding of pattern in multiplication and division • compare and order numbers up to 10 000 • read and write number words to 1000 • round numbers to the nearest 10, 100, and 1000 • represent and describe numbers to 10 000 in a variety of ways • demonstrate concretely, pictorially, and symbolically place-value concepts to give meaning to numbers up to 10 000 • sort numbers into categories using one or more attributes • demonstrate an understanding of hundredths as part of a region or set • connect proper fractions to decimal fractions (tenths and hundredths) using manipulatives, diagrams, and symbols

It is expected that students will:

Grade 5	Grade 6	Grade 7
Demonstrate a number sense for whole numbers, from 0 to 100 000, and will explore proper fractions and decimal fractions • demonstrate concretely and pictorially an understanding of place value from hundredths • read and write numerals to a million • read and write number words to 100 000 • use estimation strategies for quantities up to 100 000 • recognize, model, and describe multiples, factors, composites, and primes • compare and/or order whole numbers • represent and describe proper fractions concretely, pictorially, and symbolically • demonstrate and describe equivalent fractions • compare and order proper and decimal fractions to hundredths	Develop a number sense for common fractions and explore number sense for whole numbers • read and write numerals greater than a million • use estimation strategies for quantities up to a million • distinguish relationships among multiples, factors, composites, and primes • represent positive powers of numbers concretely, pictorially, and symbolically • use power, base, and exponent to represent repeated multiplication • explain the meaning of *integers* by extending their counting to numbers less than 0 • identify practical applications of integers • read and write numbers to thousandths • demonstrate and explain the meaning of *improper fractions* and *mixed numbers* (positive) concretely and pictorially • demonstrate and describe equivalent mixed numbers and improper fractions concretely and pictorially • compare and order improper fractions, mixed numbers, and decimal fractions to thousandths • demonstrate and explain the meaning of *ratio* concretely and pictorially • demonstrate and explain the meaning of *percentage* concretely and pictorially	Demonstrate a number sense for decimal fractions and integers (including whole numbers) • recognize, model, identify, and describe common multiples, common factors, least common multiples, greatest common factors, and prime factorization • write whole numbers as expanded numerals using powers of 10 and in scientific notation • use divisibility rules to determine whether a number is divisible by 2, 3, 4, 5, 6, 8, 9, 10, or 11 • read and write numbers to any number of decimal places • recognize and illustrate that all fractions and mixed numbers can be represented in decimal form (including terminating and repeating decimal fractions) • convert from terminating decimal fractions to common fractions and from single-digit repeating decimal numbers to common fractions using patterns • demonstrate concretely and pictorially that the sum of opposite integers is 0 • represent integers in a variety of concrete, pictorial, and symbolic ways • compare and order integers

NUMBER (NUMBER OPERATIONS)

Students demonstrate an understanding of and proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Demonstrate and use a variety of methods to show the processes of addition and subtraction on one-digit whole numbers • demonstrate and orally describe the process of addition and subtraction to 18 using role-play, manipulatives, and diagrams (memorization is not intended)	Use a variety of strategies to apply a basic operation (+, -, x, ÷) to whole numbers and use these operations in solving problems • demonstrate and describe the processes of addition and subtraction of whole numbers up to 1000 with and without regrouping, using manipulatives, diagrams, and symbols • explore and demonstrate the processes of multiplication and division up to 50, using manipulatives, diagrams, and symbols • recall addition and subtraction facts up to 18 and multiplication facts up to 25 Choose, use, and defend the appropriate calculation strategy or technology to solve problems • calculate and justify the methods they used to find sums, differences, products, and quotients using estimation strategies, mental math techniques, manipulatives, algorithms, and calculators • verify their solutions to problems by using inverse operations, estimation, and calculators	Apply arithmetic operations on whole numbers and illustrate their use in solving problems • demonstrate and describe the process of addition and subtraction of numbers up to 10 000, using manipulatives, diagrams, and symbols • demonstrate the process of multiplication (three-digit by one-digit numbers), using manipulatives, diagrams, and symbols • demonstrate the process of division (two-digit by one-digit numbers), using manipulatives, diagrams, and symbols • recall multiplication and division facts up to 81 • justify their choice of method for multiplication and division (using estimation, calculators, mental mathematics, manipulatives, algorithms) • verify solutions to multiplication and division problems by using estimation and calculators • verify solutions to multiplication and division problems by using the inverse operation Demonstrate an understanding of the addition and subtraction of decimal fractions • demonstrate an understanding of the addition and subtraction of decimal fractions (tenths and hundredths) by using concrete and pictorial representations

It is expected that students will:

Grade 5	Grade 6	Grade 7
Apply arithmetic operations on whole numbers and decimal fractions and illustrate the use of decimal fractions in solving problems • add and subtract decimal fractions to hundredths concretely, pictorially, and symbolically • estimate, mentally calculate, or compute and verify the product (three-digit by two-digit numbers) and quotient (three-digit by one-digit numbers) of the multiplication and division of whole numbers • multiply and divide decimal fractions to hundredths concretely, pictorially, and symbolically using one-digit, whole number multipliers and divisors	Apply arithmetic operations on whole numbers and decimal fractions in solving problems • estimate the solutions to calculations involving whole numbers and decimal fractions	Apply arithmetic operations on decimal fractions and integers and illustrate their use in solving problems • use patterns, manipulatives, and diagrams to demonstrate the concepts of multiplication and division by decimal fractions • use estimation strategies to predict or assess the reasonableness of their calculations • add, subtract, multiply, and divide decimal fractions (using technology for more than two-digit divisors or multipliers) • demonstrate an understanding of the order of operations, using paper and pencil and a calculator • add, subtract, multiply, and divide integers concretely, pictorially, and symbolically Illustrate the use of ratios, rates, percentages, and decimal numbers in solving problems • estimate and calculate percentages • distinguish between *rate* and *ratio* • explain and demonstrate the use of proportion in solving problems • mentally convert proper fractions, decimal fractions, and percentages from one to another to facilitate the solution of problems

PATTERNS AND RELATIONS (PATTERNS)

Students use patterns to describe the world around them and to solve problems.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Identify, create, and compare patterns that arise from their daily experiences • identify, reproduce, extend, create, and compare patterns using actions, manipulatives, diagrams, and spoken terms • recognize patterns in the environment	Investigate, establish, and communicate rules for numerical and non-numerical patterns that arise from daily and mathematical experiences, and use these rules to make predictions • identify, create, and describe number and non-number patterns • translate patterns from one mode to another using manipulatives, diagrams, charts, calculators, spoken and written terms, and symbols • explain the rule for a pattern and make predictions based on patterns using models and objects	Investigate, establish, and communicate rules for, and predictions from, numerical and non-numerical patterns • identify and explain mathematical relationships and patterns through the use of grids, tables, charts, or calculators • make and justify predictions, using numerical and non-numerical patterns

It is expected that students will:

Grade 5	Grade 6	Grade 7
Construct, extend, and summarize patterns, using rules, charts, mental mathematics, and calculators • develop charts to record and reveal number patterns • describe how a pattern grows using everyday language orally and in writing • construct and expand patterns in two and three dimensions, concretely and pictorially • generate number patterns within a problem-solving context • predict and justify pattern extensions	Use relationships to summarize, generalize, and extend patterns • construct a visual representation of a pattern to clarify relationships and to verify predictions • summarize a relationship using everyday language in spoken or written form • create expressions and rules to describe patterns and relationships (e.g., area, perimeter, volume) • interpolate number values from a given graph • predict pattern relationships	Express patterns in terms of variables and use expressions containing variables to make predictions • create formulas for finding area, perimeter, and volume • predict and justify the *n*th value of a number pattern

Patterns and Relations (Variables and Equations)

Students represent algebraic expressions in multiple ways.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Learning outcomes for Patterns and Relations (Variables and Equations) commence in Grade 6.	Learning outcomes for Patterns and Relations (Variables and Equations) commence in Grade 6.	Learning outcomes for Patterns and Relations (Variables and Equations) commence in Grade 6.

It is expected that students will:

Grade 5	Grade 6	Grade 7
Learning outcomes for Patterns and Relations (Variables and Equations) commence in Grade 6.	Use informal and concrete representations of equality and operations on equality to solve problems • generalize a pattern by substituting numbers into a frame and compare the results to the original pattern • demonstrate the meaning and the preservation of equality using objects, models, and diagrams • graph ordered pairs in the first quadrant, analyse results, and generalize relationships • solve one-variable equations with whole number coefficients and solutions using informal techniques	Use variables and equations to express, summarize, and apply relationships as problem-solving tools in a restricted range of contexts • generalize a pattern arising from a problem-solving context using an open number sentence with appropriate variables • substitute number variables and compare the results to concrete models and tables • write expressions involving variables using standard mathematical conventions • analyse relations graphically to discover how changes in one quantity may affect others • graph relations, analyse results, and draw conclusions • solve and verify simple linear equations using a variety of techniques • use patterns and relationships to represent and solve problems by translating everyday language into mathematical symbols and vice versa • explain how to solve simple problems using informal algebraic methods

SHAPE AND SPACE (MEASUREMENT)

Students describe and compare real-world phenomena using either direct or indirect measurement.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Estimate, measure, and compare measures using whole numbers and non-standard units of measure • classify, describe, and arrange objects using comparative language to compare length, size, area, weight, and volume • use comparative terms to describe time and temperature • compare the relative sizes of non-standard units by measuring the same object using different units of measurement, and recognize that different objects may have the same mass • select an appropriate non-standard unit to estimate, measure, record, compare, and order objects and containers • estimate the number of uniform objects and irregular shapes that will cover a given area and verify their estimates by covering and counting • compare and sequence events according to the duration of time (using non-standard units), time of day, days of the week, and the seasons • recognize and name the value of pennies, nickels, and dimes • use money as a form of exchange • create equivalent sets of coins up to 10¢ in value	Measure, estimate, and compare, using whole numbers and non-standard and standard units of measure • estimate, measure, record, compare, and order objects and containers using non-standard and standard units • construct a shape, length, or object using a specific non-standard unit or standard unit • select the most appropriate standard unit for measuring length (cm, m, km), mass (g, kg), volume (L), and time (minutes, hours, days) • describe relationships among various standard units of measure • relate the size of units to the number of units needed when measuring • recognize that the size and shape of an object does not necessarily determine its mass • make connections among manipulatives, diagrams, spoken terms, and written symbols • estimate and measure the passage of time in terms of seconds, minutes, hours, days, weeks, months, and years and relate the various measures to each other • read and write the date, including the days of the week and use the abbreviations and names of the months of the year in order • read and write time to the nearest minute using 12-hour notation (use both a digital and an analog clock) • estimate, read, and record temperature to the nearest degree Celsius • relate temperature to real-life situations • identify and use coins and bills (to $100) to estimate, count, record collections, create equivalent sets, and make change up to $10 • read and write both forms of money notation (89¢ and $0.89)	Estimate, measure, and compare quantities, using decimal numbers and standard units of measure • construct specific lengths (mm) • select the most appropriate standard unit (mm, cm, m, km) to measure length • describe the relationships among mm, cm, m, and km • estimate, measure, record, compare, and order objects by length, height, perimeter, and circumference using standard units (mm, cm, m, km) • estimate, measure, record, compare, and order shapes by area using standard units (cm^2, m^2) • construct a number of shapes given a specific area (cm^2) • select the most appropriate standard unit to measure area • relate the number of units needed to the size of the units to measure the area of an object • estimate, measure, record, compare, and order the capacity of containers using standard units (mL, L) • relate the number of units needed to the size of the units to measure the mass of an object • describe the relationship between grams and kilograms • solve problems involving mass using grams and kilograms • relate years, decades, centuries, and millenniums • read and write time on a 24-hour clock • read and write time using a.m. and p.m. • estimate, count, and record collections of coins and bills up to $100 • make purchases and change up to $100

It is expected that students will:

Grade 5	Grade 6	Grade 7
Use measurement concepts, appropriate tools, and the results of measurements to solve problems in real-life contexts • recognize and explain the meaning of length, width, height, depth, thickness, perimeter, and circumference • solve problems involving mass using grams, kilograms, and tonnes • evaluate which units of measure would be most appropriate when selecting different measuring tools • estimate and measure the area of irregular shapes by dividing them into parts • estimate and measure the perimeter of irregular shapes • estimate and measure the effect on a rectangle's perimeter or area of changing one or more of its dimensions • relate the perimeter and area of a rectangle using manipulatives and diagrams • relate the units cm^3 and mL • estimate, measure, record, and order containers by volume using cm^3 • construct objects of a specific volume expressed in cm^3 • read and write SI notation for recording dates and time	Be able to solve problems involving perimeter, area, surface area, volume, and angle measurement • convert between commonly used SI units of length, mass, and capacity • develop, verify, and use rules or expressions to determine the perimeter of polygons • develop, verify, and use rules or expressions to determine the area of rectangles • estimate, measure, and then calculate the surface area of right rectangular prisms (without using a formula) • discover, generalize, and use rules to determine the volume of right rectangular prisms • determine the volume of an object by measuring the amount of liquid displaced by that object (cm^3 or mL) • recognize angles as being more than 90°, equal to 90°, less than 90°, or greater than 180° • estimate and measure angles using a circular protractor • draw and sketch an angle in which the degrees in the angle are specified • classify given angles as acute, right, obtuse, straight, or reflex • identify and compare examples of angles in the environment	Solve problems involving the properties of circles and their relationships to angles and time zones • measure the diameter, radius, and circumference of circles and generalize the relationships • solve problems involving circles (radius, diameter, and circumference) • explain how time zones are determined • determine time in various regions of the world • research and report how measurement instruments are used in the community • design and construct rectangles, given either or both the perimeter and the area (in whole numbers) • demonstrate and generalize that many rectangles are possible for a given perimeter or a given area

SHAPE AND SPACE (3-D OBJECTS AND 2-D SHAPES)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Explore, sort, and classify real-world and three-dimensional objects according to their properties • explore and describe real-world and three-dimensional objects using descriptive attributes such as *big, little, like a box,* and *like a can* • explore, identify, and classify three-dimensional objects in the environment according to their properties • construct three-dimensional objects using materials such as plasticine, blocks, and boxes • identify and describe specific two-dimensional shapes such as circles, squares, triangles, or rectangles • construct and rearrange a design using a set of two-dimensional shapes • compare, sort, classify, and pattern two-dimensional shapes	Describe, classify, construct, and relate three-dimensional objects and two-dimensional shapes using common language to describe their properties • compare, contrast, sort, and classify two-dimensional shapes and three-dimensional objects using two or more attributes • identify, count, and describe the faces, vertices, edges, sides, and angles of polygons and solids • describe and name three-dimensional objects (cubes, spheres, cones, cylinders, pyramids, and prisms) and use appropriate two-dimensional names to describe their faces • describe and name pyramids and prisms by the shape of the base • construct skeletons of a three-dimensional object from a model and relate the skeletons (nets) to models • demonstrate through dismantling that a rectangular solid has more than one net • make identical, congruent two-dimensional shapes • construct and rearrange a design using a set of two-dimensional shapes • recognize congruent three-dimensional objects and two-dimensional shapes in the environment • explore the concepts of points, lines, perpendicular lines, parallel lines, and intersecting lines on three-dimensional objects	Describe, classify, construct, and relate three-dimensional objects and two-dimensional shapes, using mathematical vocabulary to describe their properties • design and construct nets for pyramids and prisms • relate nets to three-dimensional objects • compare and contrast pyramids and prisms to describe a relationship • identify and sort specific quadrilaterals, such as squares, rectangles, parallelograms, and trapezoids • classify angles in a variety of orientations according to whether they are a right angle, less than a right angle, or greater than a right angle • recognize, draw, and name the following: point, line, parallel lines, and intersecting lines

It is expected that students will:

Grade 5	Grade 6	Grade 7
Use the visualization of two-dimensional shapes and three-dimensional objects to solve problems related to spatial relation • construct, analyse, and classify triangles according to their side measurements • build, represent, and describe geometric objects and shapes • classify and name polygons according to the number of their sides (3, 4, 5, 6, 8) • cover two-dimensional shapes with a set of tangram pieces • complete the drawing of a three-dimensional object on grid paper given the front face • determine experimentally the minimum information needed to draw or identify a given two-dimensional shape	Use visualization and symmetry to solve problems involving classification and sketching • classify triangles according to the measurement of their angles • sort quadrilaterals and regular polygons according to the number of lines of symmetry • recognize and describe optical illusions • reproduce a given geometric drawing on grid paper • sketch three-dimensional solids and skeletons with or without grids	Link angle measurements to the properties of parallel lines • measure and classify pairs of angles, complementary angles (90°), or supplementary angles (180°) • identify and name pairs of angles pertaining to parallel lines and transversals, including: - corresponding angles - vertically opposite angles - interior angles on the same side of the transversal - exterior angles on the same side of the transversal - interior alternate angles • describe the relationships between the pairs of angles pertaining to parallel lines and transversals • use mathematical reasoning to determine the measures of angles in a diagram • perform calculations with angle measures • construct angle bisectors and perpendicular bisectors • explain in more than one way why the sum of the measures of the angles of a triangle is 180°

SHAPE AND SPACE (TRANSFORMATIONS)

Students perform, analyse, and create transformations.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Describe verbally the relative position of both three-dimensional objects and two-dimensional shapes • use directional terms such as *over*, *under*, *beside*, *near*, *far*, *left*, and *right* to describe the relative position of objects and shapes • match the size and shape of figures by superimposing one on top of another • identify and fit pieces of puzzles or shapes that go together (part to whole relationship) • explore and describe reflection in mirrors	Use positional language, numbers, and directional words to describe the relative positions of objects in one dimension and to communicate motion in real-world contexts • communicate and apply positional language and cardinal directions (relating to compasses and maps) in verbal, written, or numerical form • graph whole number points on a horizontal or a vertical number line • trace a path on a line following oral or written instructions • make congruent shapes and symmetrical two-dimensional shapes using folds and reflections	Use numbers and directional words to describe the relative positions of objects in two dimensions, using real-world contexts • communicate and apply terms of directions to maps (north, south, east, and west) • place an object on a grid using columns and rows • describe the position of an object on a grid using columns and rows • trace a path on a grid or map, using oral or written instructions (and vice versa) • create and verify symmetrical two-dimensional shapes by drawing lines of symmetry

It is expected that students will:

Grade 5	Grade 6	Grade 7
Describe motion in terms of a slide, a turn, or a flip • recognize motion as a slide (translation), a turn (rotation), or a flip (reflection) • recognize tessellations created with regular and irregular shapes in the environment • locate planes of symmetry by cutting solids • use coordinates to describe the position of objects in two dimensions • plot whole number, ordered number pairs in the first quadrant with intervals of 1, 2, 5, and 10 • identify a point in the first quadrant using ordered pairs • cover a surface using one or more tessellating shapes • create and identify tessellations using regular polygons • identify regular polygons that can tessellate a plane	Create patterns and designs that incorporate symmetry, translations, tessellations, and reflections • create, analyse, and describe designs using translations (slides) and reflections (flips) • draw designs using ordered pairs in the first quadrant of the coordinate grid, together with slide and flip images	Create and analyse patterns and designs using congruence, symmetry, translation, rotation, and reflection • create, analyse, and describe designs using rotation (turns), reflections (flips), and translations (slides) • use informal concepts of congruence to describe images after rotations (turns), reflections (flips), and translations (slides) • draw designs using ordered pairs in all four quadrants of the coordinate grid, together with slide and flip images • connect reflections with lines and planes of symmetry

STATISTICS AND PROBABILITY (DATA ANALYSIS)

Students collect, display, and analyse data to make predictions about a population.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Collect, organize, and analyse (with assistance) data based on first-hand information • collect first-hand information by counting objects, conducting surveys, measuring, and performing simple experiments • sort objects to one attribute chosen by themselves or the teacher • construct a pictograph using one-to-one correspondence • compare data using appropriate language, including quantitative terms • pose oral questions in relation to the data gathered	Collect data based on first- and second-hand information, display results in more than one way, interpret data, and make predictions • formulate questions and categories for data collection and actively collect first-hand information • use a variety of methods to collect and record data, including measuring devices, printed resources, and tallies • sort and organize data by one or more attributes and by using graphic organizers such as lists and charts • identify attributes and rules in pre-sorted sets • display data in more than one way, including graphs, pictographs, bar graphs, and rank ordering • discuss data, communicate conclusions, and make predictions and inferences to solve similar problems • generate new questions from displayed data • obtain new information by performing arithmetic operations on the data	Collect first- and second-hand data, assess and validate the data-collection process, and graph the data • select an appropriate sample or population and organize the collection of data • manipulate data to create an interval graph/table for display purposes • construct a bar graph and a pictograph using many-to-one correspondence and justify the choice of intervals and correspondence used • evaluate the process by which the data was collected

It is expected that students will:

Grade 5	Grade 6	Grade 7
Develop and implement a plan for the collection, display, and analysis of data gathered from appropriate samples • identify a question to generate appropriate data and predict results • distinguish between a total population and a sample • use a variety of methods to collect and record data • create classifications and ranges for grouping data • display data by hand or by computer in a variety of ways, including: - frequency diagrams - line plots - broken-line graphs • evaluate the graphic presentation of the data to ensure the clear representation of the results • discuss the reasonableness of the data and the results • make inferences from the data to generate a conclusion	Develop and implement a plan for the collection, display, and analysis of data gathered from appropriate samples • formulate a key question from a problem-solving context • identify appropriate data sources (first-hand, second-hand, a combination of first- and second-hand) • select and justify appropriate methods of collecting data (designing and using structured questionnaires, experiments, observations, and electronic networks) • select and justify the choice of an appropriate population sample to use to answer a particular question • discuss how the data collected are affected by the nature of the sample, the method of collection, the sample size, and biases • display data by hand or by computer in a variety of ways, including histograms, double bar graphs, and stem and leaf plots • read and interpret graphs that are provided • describe the general distribution of data: - smallest and largest value - frequency (which occurs most often/least often) - value in the middle - patterns • analyse sets of data to make comparisons and test predictions	Develop and implement a plan for the collection, display, and analysis of data, using measures of variability and central tendency • formulate questions that explore whether or not a relationship exists in a real-world context • select and justify appropriate methods of collecting data (designing and using questionnaires, interviews, experiments, and research) • display data by hand or by computer in a variety of ways, including circle graphs • read and interpret graphs that are provided • determine measures of central tendency for a set of data: - mode - median - mean • determine measures of the distribution of a set of data: - range - extremes, gaps, and clusters - quartiles • interpolate from data to make predictions

STATISTICS AND PROBABILITY (CHANCE AND UNCERTAINTY)

Students use experimental or theoretical probability to represent and solve problems involving uncertainty.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
Describe concepts of chance and chance events using ordinary vocabulary • predict the chance of an event happening using the terms *never*, *sometimes*, and *always*	Use simple experiments designed by others to illustrate and explain probability and chance • describe the likeliness of an outcome using terms such as *likely*, *unlikely*, *fair chance*, *probable*, and *expected* • conduct a probability experiment, choose an appropriate recording method, and draw conclusions and make predictions from the results	Conduct simple probability experiments to explain outcomes • identify an outcome using the terms *possible*, *impossible*, *certain*, or *uncertain* • compare outcomes using the terms *equally*, *likely*, *more likely*, or *less likely* • design and conduct experiments to answer their own questions

It is expected that students will:

Grade 5	Grade 6	Grade 7
Predict outcomes, conduct experiments, and communicate the probability of single events • list all possible outcomes of an event • explain events using the vocabulary of probability - *best/worst* - *probable/improbable* - *never/less likely/equally likely* - *likely/more likely/always* • conduct probability experiments and explain the results using the vocabulary of probability • conduct probability experiments to demonstrate that results are not influenced by factors such as the age, experience, or skill of the participant	Use numbers to communicate the probability of single events from experiments and models • distinguish between the experimental and theoretical probability of single events • using various polyhedrons as dice, identify the relationship between the number of faces and the probability of a single event • calculate theoretical probability using numbers between 0 and 1 • demonstrate that different outcomes may occur when the same experiment is repeated • compare experimental results with theoretical results	Create and solve problems using probability • use a table to identify all possible outcomes of two independent events • use simulation or experimentation to solve probability problems • create and solve problems using the definition of probability as favourable outcomes over total outcomes

Appendix B

Learning Resources
General Information

WHAT IS APPENDIX B?

Appendix B consists of general information on learning resources, as well as Grade Collection information and alphabetical annotations of the provincially recommended resources.

WHAT IS A GRADE COLLECTION?

A Grade Collection is the format used to organize the provincially recommended learning resources by grade and by curriculum organizer. It can be regarded as a 'starter set' of basic resources to deliver the curriculum. In many cases, the Grade Collection provides a choice of more than one resource to support curriculum organizers, enabling teachers to select resources that best suit different teaching and learning styles. There may be prescribed learning outcomes either partially or not at all supported by learning resources at this time. Many of these are best met by teacher-developed activities. Teachers may also wish to supplement Grade Collection resources with locally selected materials.

WHAT KINDS OF RESOURCES ARE FOUND IN A GRADE COLLECTION?

Learning resources in a Grade Collection are categorized as either *comprehensive* or *additional. Comprehensive resources* provide a broad coverage of the learning outcomes for most curriculum organizers. A*dditional resources* are more topic specific and support individual curriculum organizers or clusters of outcomes. They provide valuable support for or extension to specific topics and are typically used to supplement or fill in the areas not covered by the comprehensive resources.

HOW ARE GRADE COLLECTIONS KEPT CURRENT?

Under the provincial continuous submissions process, suppliers advise the ministry about newly developed resources as soon as they are released. Resources judged to have a potentially significant match to the learning outcomes for individual IRPs are evaluated by practising classroom teachers who are trained by ministry staff to use provincial evaluation criteria. Resources selected for provincial recommendation receive Ministerial Order and are added to the existing Grade Collections. The ministry updates the Grade Collections on a regular basis on the ministry web site at http://www.bced.gov.bc.ca/irp_resources/lr/resource/gradcoll.htm. Please check this site for the most current and up-to-date version of Appendix B.

HOW LONG DO LEARNING RESOURCES KEEP THEIR RECOMMENDED STATUS?

Learning resources will retain their recommended status for a minimum of five years after which time they may be withdrawn from the Grade Collections, thereby terminating their provincially recommended status. Decisions regarding the withdrawal of learning resources will be based on, but not limited to, considerations of curriculum support, currency, and availability. Schools may continue to use a learning resource after withdrawal provided local school board approval is obtained.

HOW CAN TEACHERS CHOOSE LEARNING RESOURCES TO MEET THEIR CLASSROOM NEEDS?

As outlined in *Evaluating, Selecting and Managing Learning Resources: A Guide* (Revised 2000), there are a number of approaches to selecting learning resources.

Teachers may choose to use:
- provincially recommended resources to support provincial or locally developed curricula
- resources that are not on the ministry's provincially recommended list (resources that are not on the provincially recommended list must be evaluated through a local, board-approved process).

The Ministry of Education has developed a variety of tools and guidelines to assist teachers with the selection of learning resources. These include:
- *Evaluating, Selecting and Managing Learning Resources: A Guide* (Revised 2000) with accompanying CD-ROM tutorial and evaluation instruments
- Grade Collection(s) in each IRP. Each Grade Collection begins with a chart which lists both comprehensive and additional resources for each curriculum organizer. The chart is followed by an annotated bibliography with supplier and ordering information. (Price and supplier information should be confirmed at the time of ordering). There is also a chart that lists Grade Collection titles alphabetically and a blank planning template that can be used by teachers to record their individual choices
- Resource databases on CD-ROM or on-line
- Sets of recommended learning resources are available in a number of host districts throughout the province to allow teachers to examine the materials first hand at regional displays.
- *Catalogue of Recommended Learning Resources*

WHAT ARE THE CRITERIA TO CONSIDER WHEN SELECTING LEARNING RESOURCES?

There are a number of factors to consider when selecting learning resources.

Content

The foremost consideration for selection is the curriculum to be taught. Prospective resources must adequately support the particular learning objectives that the teacher wants to address. Teachers will determine whether a resource will effectively support any given learning outcomes within a curriculum organizer. This can only be done by examining descriptive information regarding that resource; acquiring additional information about the material from the supplier, published reviews, or colleagues; and by examining the resource first-hand.

Instructional Design

When selecting learning resources, teachers must keep in mind the individual learning styles and abilities of their students, as well as anticipate the students they may have in the future. Resources should support a variety of special audiences, including gifted, learning disabled, mildly intellectually disabled, and ESL students. The instructional design of a resource includes the organization and presentation techniques; the methods used to introduce, develop, and summarize concepts; and the vocabulary level. The suitability of all of these should be considered for the intended audience.

Teachers should also consider their own teaching styles and select resources that will complement them. The list of recommended resources contains materials that range from prescriptive or self-contained resources, to open-ended resources that require

considerable teacher preparation. There are recommended materials for teachers with varying levels and experience with a particular subject, as well as those that strongly support particular teaching styles.

Technical Design

While the instructional design of a package will determine the conceptual organization, it is the technical design that brings that structure into reality. Good technical design enhances student access and understanding. Poor technical quality creates barriers to learning. Teachers should consider the quality of photographs and illustrations, font size and page layout, and durability. In the case of video, audible and age appropriate narration and variation in presentation style should be considered. When selecting digital resources, interactivity, feedback, constructive engagement, usability, and functionality are important.

Social Considerations

An examination of a resource for social considerations helps to identify potentially controversial or offensive elements which may exist in the content or presentation. Such a review also highlights where resources might support pro-social attitudes and promote diversity and human rights issues.

The intent of any Social Considerations screening process, be it at the local or provincial level, is not to remove controversy, but to ensure that controversial views and opinions are presented in a contextual framework.

All resources on the ministry's recommended list have been thoroughly screened for social concerns from a provincial perspective. However, teachers must consider the appropriateness of any resource from the perspective of the local community.

Media

When selecting resources, teachers should consider the advantages of various media. Some topics may be best taught using a specific medium. For example, video may be the most appropriate medium when teaching a particular, observable skill, since it provides a visual model that can be played over and over or viewed in slow motion for detailed analysis. Video can also bring otherwise unavailable experiences into the classroom and reveal "unseen worlds" to students. Software may be particularly useful when students are expected to develop critical-thinking skills through the manipulation of a simulation, or where safety or repetition are factors. Print or CD-ROM resources can best be used to provide extensive background information on a given topic. Once again, teachers must consider the needs of their individual students, some of whom may learn better from the use of one medium than another.

USE OF INFORMATION TECHNOLOGY

Teachers are encouraged to embrace a variety of educational technologies in their classrooms. To do so, they will need to ensure the availability of the necessary equipment and familiarize themselves with its operation. If the equipment is not currently available, then the need must be incorporated into the school or district technology plan.

WHAT FUNDING IS AVAILABLE FOR PURCHASING LEARNING RESOURCES?

As part of the selection process, teachers should be aware of school and district funding policies and procedures to determine how much money is available for their needs. Funding for various purposes, including the purchase of learning resources, is provided to school districts.

Learning resource selection should be viewed as an ongoing process that requires a determination of needs, as well as long-term planning to co-ordinate individual goals and local priorities.

EXISTING MATERIALS

Prior to selecting and purchasing new learning resources, an inventory of those resources that are already available should be established through consultation with the school and district resource centres. In some districts, this can be facilitated through the use of district and school resource management and tracking systems. Such systems usually involve a computer database program (and possibly bar-coding) to help keep track of a multitude of titles. If such a system is put on-line, then teachers can check the availability of a particular resource via computer.

Appendix B

Mathematics K to 7
Grade Collections

MATHEMATICS K TO 7 : GRADE COLLECTIONS

This section begins with an overview of the comprehensive resources for this curriculum, then presents Grade Collection charts for each grade. These charts list both *comprehensive* and *additional* resources for each curriculum organizer for the grade. The charts are followed by an annotated bibliography. Teachers should check with suppliers for complete and up-to-date ordering information. Most suppliers maintain web sites that are easy to access.

The learning resources identified in the Mathematics K to 7 Grade Collections have been evaluated through the Western Canadian Protocol Learning Resources Evaluation process and subsequently have been given Provincially Recommended status by the Ministry of Education.

MEDIA ICONS KEY


Audio Cassette


CD-ROM


Film


Games/Manipulatives


Laserdisc/Videodisc


Multimedia

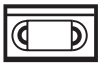

Music CD


Print Materials


Record


Slides


Software


Video

MATHEMATICS K TO 7 GRADE COLLECTIONS OVERVIEW OF COMPREHENSIVE RESOURCES

Interactions (Grades K to 7)

Activity-based math program is designed to stimulate mathematical thinking and to help students be flexible problem solvers and develop positive attitudes toward math. For primary grades, the components include a teachers resource binder, blackline masters, activity cards and booklets. For Kindergarten and Grade 2, there is also s a math literature pack with big books, small books and audio cassettes. For Grades 4 to 7, the components comprise a student book and teachers resource book, which is essential in developing appropriate concept depth. There are additional assessment booklets and blackline masters for Grade 7. A glossary is not included. Effective use of this program requires familiarity with all of the components and how they coordinate. Teachers will need to supplement the learning outcomes for 3-D objects and 2-D shapes at the Grade 6 level and geometrical transformations at the Grade 7 level. References to technology are lacking.

The Learning Equation: Mathematics 7 (Grade 7)

Interactive CD-ROMs for Macintosh or Windows present lessons in the consistent format of introduction, tutorial example, summary of concepts, practice problems, extra practice and a self-check. Students are able to monitor their own progress through the various components of each lesson, set the sound level to their own liking and control the pace. The program uses many "explorers," which allow students to simulate mathematics concepts. Also included on the CD-ROMs is a glossary that students can access as a pull-down menu. Print support consists of a student refresher and a teachers manual. The student refresher follows the organization of the CD-ROMs and provides additional examples and answers. The teacher's manual includes installation notes, instructional summaries, prerequisite skills, and cross-references to the CD-ROMs.

MATHPOWER 7, Western Edition (Grade 7)

Program presents concepts and skills in a problem-solving context. Components include a student text, teachers guide and blackline masters. Requires the use of manipulatives and integrates the use of appropriate technology. Teachers may need to augment the processes related to estimation and mental math.

Mathworks: Book A (Grade 1)

Activity-based math program comprising a teachers resource book, blackline masters and gameboards, builds on the students world of experience and interests. Focusses on mathematical thinking, reasoning and problem solving. Teachers will need to provide additional activities to extend development of addition and subtraction concepts to eighteen.

Minds on Math 7, Revised Edition (Grade 7)

Program engages students in meaningful, real-world mathematics. Chapters in the student book begin with activities and exercises that allow students to assess their prior knowledge before they explore new concepts. Accompanied by a teachers resource book, template and data disk and activity cards. Requires the use of manipulatives; these are not supplied with the resource. Software requires ClarisWorks or Microsoft Works.

Quest 2000: Exploring Mathematics
(Grades K to 6)

Activity-based math program is designed to stimulate students to use mathematics to solve problems, to communicate their mathematical thinking, and to build a lifelong appreciation of an ability to use mathematics in everyday life. Components include a student book, teachers guide and journal, blackline masters, teachers support package, problem of the week transparencies, estimation and mental math activities, activity cards for exploration centres and a professional handbook. For Grades 3 to 6, there is also a technology package requiring either ClarisWorks 2.0 or Microsoft Works 3.0 or later.

Mathematics Grade K Collection

	Number		Patterns and Relations			Shape and Space			Statistics and Probability	
	Number Concepts	Number Operations	Patterns	Variables & Equations	Relations & Functions	Measurement	3-D Objects & 2-D Shapes	Transformations	Data Analysis	Chance & Uncertainty
Comprehensive Resources										
Interactions (Level Kindergarten)										
Quest 2000: Exploring Mathematics (Grade K)										
Additional Resources - Print										
Math Discoveries: Grades K-1			✓			✓	✓	✓		
Additional Resources – Video										
Tick Tock: All About the Clock						✓				
Additional Resources – Games & Manipulatives										
Architek (English Version)			✓				✓	✓		
Learn with "Matty" on the Calcu-Mat	✓	✓	✓							
Additional Resources – Software & CD-ROM										
ABCirque!	✓		✓			✓				
The Graph Club									✓	
Graphers									✓	
Mighty Math Carnival Countdown	✓	✓	✓							

	For the comprehensive resources, indicates satisfactory to good support for the majority of the learning outcomes within the curriculum organizer.
✓	For the additional resources, indicates support for one or more learning outcomes within the curriculum organizer.
	Indicates minimal or no support for the prescribed learning outcomes within the curriculum organizer.
	Indicates that the curriculum sub-organizer is not included at this grade level

Mathematics Grade 1 Collection

	Number		Patterns and Relations			Shape and Space			Statistics and Probability	
	Number Concepts	Number Operations	Patterns	Variables & Equations	Relations & Functions	Measurement	3-D Objects & 2-D Shapes	Transformations	Data Analysis	Chance & Uncertainty
Comprehensive Resources										
Interactions (Level 1)										
Mathworks: Book A										
Quest 2000: Exploring Mathematics (Grade 1)										
Additional Resources - Print										
101 Winning Ways with Base 10	✓									
Math Discoveries: Grades K-1			✓			✓	✓	✓		
Math Discoveries: Grades 1-3	✓		✓			✓	✓	✓		
The Show & Tell Geoboard Collection	✓		✓				✓	✓		
Additional Resources – Video										
Tick Tock: All About the Clock						✓				
Additional Resources – Games & Manipulatives										
Architek (English Version)			✓				✓	✓		
Learn with "Matty" on the Calcu-Mat	✓	✓	✓							
Additional Resources – Software & CD-ROM										
The Graph Club									✓	
Graphers									✓	
Mighty Math Carnival Countdown	✓	✓	✓							
Mosaic Magic: A Toy, Creativity Tool, and Math Teacher All in One			✓					✓		

	For the comprehensive resources, indicates satisfactory to good support for the majority of the learning outcomes within the curriculum organizer.
✓	For the additional resources, indicates support for one or more learning outcomes within the curriculum organizer.
	Indicates minimal or no support for the prescribed learning outcomes within the curriculum organizer.
	Indicates that the curriculum sub-organizer is not included at this grade level

Mathematics Grade 2 Collection

	Number		Patterns and Relations			Shape and Space			Statistics and Probability	
	Number Concepts	Number Operations	Patterns	Variables & Equations	Relations & Functions	Measurement	3-D Objects & 2-D Shapes	Transformations	Data Analysis	Chance & Uncertainty
Comprehensive Resources										
Interactions (Level 2)										
Quest 2000: Exploring Mathematics (Grade 2)										
Additional Resources - Print										
101 Winning Ways with Base 10	✓									
Geometry: Grade 2							✓			
Math Discoveries: Grades 1-3	✓		✓			✓	✓	✓		
Math Discoveries: Grades 2-3			✓			✓	✓	✓		
The Show & Tell Geoboard Collection	✓		✓				✓	✓		
Additional Resources – Video										
Tick Tock: All About the Clock						✓				
Additional Resources – Games & Manipulatives										
Architek (English Version)			✓				✓	✓		
Additional Resources – Software & CD-ROM										
The Graph Club									✓	
Graphers									✓	
Mighty Math Carnival Countdown	✓	✓	✓							
Mirror Symmetry								✓		
Mosaic Magic: A Toy, Creativity Tool, and Math Teacher All in One			✓					✓		

	For the comprehensive resources, indicates satisfactory to good support for the majority of the learning outcomes within the curriculum organizer.
✓	For the additional resources, indicates support for one or more learning outcomes within the curriculum organizer.
	Indicates minimal or no support for the prescribed learning outcomes within the curriculum organizer.
	Indicates that the curriculum sub-organizer is not included at this grade level

Mathematics Grade 3 Collection

	Number		Patterns and Relations			Shape and Space			Statistics and Probability	
	Number Concepts	Number Operations	Patterns	Variables & Equations	Relations & Functions	Measurement	3-D Objects & 2-D Shapes	Transformations	Data Analysis	Chance & Uncertainty
Comprehensive Resources										
Interactions (Level 3)										
Quest 2000: Exploring Mathematics (Grade 3)										
Additional Resources - Print										
101 Winning Ways with Base 10	✓									
Math Discoveries: Grades 1-3	✓		✓			✓	✓	✓		
Math Discoveries: Grades 2-3			✓			✓	✓	✓		
Math Discoveries: Grades 3-4	✓	✓	✓			✓	✓		✓	✓
The Show & Tell Geoboard Collection	✓		✓				✓	✓		
Additional Resources – Video										
Tick Tock: All About the Clock						✓				
Additional Resources – Games & Manipulatives										
Architek (English Version)			✓				✓	✓		
Additional Resources – Software & CD-ROM										
The Graph Club									✓	
Graphers									✓	
Mathville Mindway	✓	✓	✓			✓	✓	✓		✓
Mirror Symmetry								✓		
Mosaic Magic: A Toy, Creativity Tool, and Math Teacher All in One			✓					✓		

	For the comprehensive resources, indicates satisfactory to good support for the majority of the learning outcomes within the curriculum organizer.
✓	For the additional resources, indicates support for one or more learning outcomes within the curriculum organizer.
	Indicates minimal or no support for the prescribed learning outcomes within the curriculum organizer.
	Indicates that the curriculum sub-organizer is not included at this grade level

Mathematics 4 Grade Collection

	Number		Patterns and Relations			Shape and Space			Statistics and Probability	
	Number Concepts	Number Operations	Patterns	Variables & Equations	Relations & Functions	Measure-ment	3-D Objects & 2-D Shapes	Transform-ations	Data Analysis	Chance & Uncertainty
Comprehensive Resources										
Interactions (Level 4)										
Quest 2000: Exploring Mathematics (Grade 4)										
Additional Resources - Print										
101 Winning Ways with Base 10: Activities for Grades 4-6	✓	✓								
Math Discoveries: Grades 3-4	✓	✓	✓			✓	✓		✓	✓
The Show & Tell Geoboard Collection	✓		✓				✓	✓		
Additional Resources – Software & CD-ROM										
Data Explorer									✓	
Graphers									✓	
Hot Dog Stand: The Works	✓	✓							✓	
Math Tools	✓	✓	✓			✓	✓	✓	✓	✓
Mathville Mindway	✓	✓	✓			✓	✓	✓		✓
Mirror Symmetry								✓		
Mosaic Magic: A Toy, Creativity Tool, and Math Teacher All in One			✓					✓		

	For the comprehensive resources, indicates satisfactory to good support for the majority of the learning outcomes within the curriculum organizer.
✓	For the additional resources, indicates support for one or more learning outcomes within the curriculum organizer.
	Indicates minimal or no support for the prescribed learning outcomes within the curriculum organizer.

Mathematics 5 Grade Collection

	Number		Patterns and Relations			Shape and Space			Statistics and Probability	
	Number Concepts	Number Operations	Patterns	Variables & Equations	Relations & Functions	Measure-ment	3-D Objects & 2-D Shapes	Transform-ations	Data Analysis	Chance & Uncertainty
Comprehensive Resources										
Interactions (Level 5)										
Quest 2000: Exploring Mathematics (Grade 5)										
Additional Resources - Print										
101 Winning Ways with Base 10: Activities for Grades 4-6	✓	✓								
The Geoboard Portfolio						✓		✓		
Math Discoveries: Grades 5-6	✓	✓	✓			✓	✓	✓	✓	✓
Additional Resources – Video										
Solve It Series (Grade 5)	✓	✓	✓			✓	✓		✓	
Additional Resources – Software & CD-ROM										
Adventures in Fight	✓	✓	✓			✓		✓		
Data Explorer									✓	
Hot Dog Stand: The Works	✓	✓							✓	
Math Tools	✓	✓	✓			✓	✓	✓	✓	✓
Mathville Mindway	✓	✓	✓			✓	✓	✓		✓
Mirror Symmetry								✓		
Mosaic Magic: A Toy, Creativity Tool, and Math Teacher All in One			✓					✓		
TesselMania								✓		

	For the comprehensive resources, indicates satisfactory to good support for the majority of the learning outcomes within the curriculum organizer.
✓	For the additional resources, indicates support for one or more learning outcomes within the curriculum organizer.
	Indicates minimal or no support for the prescribed learning outcomes within the curriculum organizer.

Mathematics 6 Grade Collection

	Number		Patterns and Relations			Shape and Space			Statistics and Probability	
	Number Concepts	Number Operations	Patterns	Variables & Equations	Relations & Functions	Measure-ment	3-D Objects & 2-D Shapes	Transform-ations	Data Analysis	Chance & Uncertainty
Comprehensive Resources										
Interactions (Level 6)										
Quest 2000: Exploring Mathematics (Grade 6)										
Additional Resources - Print										
101 Winning Ways with Base 10: Activities for Grades 4-6	✓	✓								
The Geoboard Portfolio						✓		✓		
Math Discoveries: Grades 5-6	✓	✓	✓			✓	✓	✓	✓	✓
Additional Resources – Video										
Statistics: Sampling									✓	
Additional Resources – Software & CD-ROM										
Data Explorer									✓	
Hot Dog Stand: The Works	✓	✓							✓	
Math Tools	✓	✓	✓	✓		✓	✓	✓	✓	✓
Mathville VIP	✓	✓	✓			✓	✓	✓		✓
Mirror Symmetry								✓		
Mosaic Magic: A Toy, Creativity Tool, and Math Teacher All in One			✓					✓		
TesselMania								✓		

	For the comprehensive resources, indicates satisfactory to good support for the majority of the learning outcomes within the curriculum organizer.
✓	For the additional resources, indicates support for one or more learning outcomes within the curriculum organizer.
	Indicates minimal or no support for the prescribed learning outcomes within the curriculum organizer.

Mathematics 7 Grade Collection

	Number		Patterns and Relations			Shape and Space			Statistics and Probability	
	Number Concepts	Number Operations	Patterns	Variables & Equations	Relations & Functions	Measure-ment	3-D Objects & 2-D Shapes	Transform-ations	Data Analysis	Chance & Uncertainty
Comprehensive Resources										
Interactions (Level 7)										
The Learning Equation: Mathematics 7										
MATHPOWER 7, Western Edition										
Minds on Math 7, Revised Edition										
Additional Resources - Print										
Dealing with Data: Probability and Sampling										✓
The Geoboard Portfolio						✓		✓		
The Intermediate Geoboard	✓	✓				✓	✓	✓		
Numbers and Patterns: Investigating Rate, Ratio, and Proportion		✓					✓			
Triple 'A' Mathematics Program: Data Management & Probability									✓	✓
Additional Resources – Games & Manipulatives										
Step Up	✓	✓								
Additional Resources – Software & CD-ROM										
The Geometer's Sketchpad						✓	✓	✓		
Geometry Blaster						✓	✓	✓		
Hot Dog Stand: The Works	✓	✓							✓	
Math Tools	✓	✓	✓	✓		✓	✓	✓	✓	✓
Mathville VIP	✓	✓	✓			✓	✓	✓		✓
Mirror Symmetry								✓		
Pre-Algebra Math Blaster Mystery: The Great Brain Robbery – Teachers' Edition	✓	✓								
Statistics Workshop									✓	
Understanding Math Series	✓	✓	✓	✓		✓		✓		

	For the comprehensive resources, indicates satisfactory to good support for the majority of the learning outcomes within the curriculum organizer.
✓	For the additional resources, indicates support for one or more learning outcomes within the curriculum organizer.
	Indicates minimal or no support for the prescribed learning outcomes within the curriculum organizer.

101 Winning Ways with Base 10: Activities for Grades 1-3

Author(s): Cross, M.; Hulland, J.

General Description:

Resource binder comprises a sequenced set of problem-solving activities that focus on base ten materials. Blackline master activity sheets help students develop an understanding of counting, place value, regrouping and decimals. Supports active learning, oral language and student record keeping.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
	✓	✓	✓									

Year Recommended in Grade Collection: 1999

Supplier: *Exclusive Educational Products*
243 Saunders Road
Barrie, ON L4N 9A3

Tel: (705) 725-1166 **Fax:** (705) 725-1167

Toll Free: 1-800-563-1166

Web Address: www.exclusiveeducational.ca

Price: $31.46

ISBN/Order No: Not available

Copyright: 1989

---

101 Winning Ways with Base 10: Activities for Grades 4-6

Author(s): Cross, Marian Dr.; Hulland, Jan

General Description:

Resource binder comprises a sequenced set of problem-solving activities that focus on base ten materials. Blackline master activity sheets help students develop an understanding of counting, estimating, place value, regrouping and decimals. Supports active learning, oral language and student record keeping. Emphasizes estimation skills.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
				✓	✓	✓						

Year Recommended in Grade Collection: 1999

Supplier: *Exclusive Educational Products*
243 Saunders Road
Barrie, ON L4N 9A3

Tel: (705) 725-1166 **Fax:** (705) 725-1167

Toll Free: 1-800-563-1166

Web Address: www.exclusiveeducational.ca

Price: $31.46

ISBN/Order No: 0061

Copyright: 1990

ABCirque! (English Macintosh / Windows Version)

General Description:

CD-ROM for Macintosh and Windows provides a set of eight educational games designed to help children learn to read and count. The games, organized around a circus theme, allow students to choose among letters, numbers and geometrical shapes. There is no accompanying user's guide.

System Requirements:
Macintosh: System 7.0 or higher; 68020, 68030, 68040 processor or PowerPC; 4 Mb RAM; 256 colour 640 x 480 monitor; CD drive.
Windows 3.1: 486 processor or faster, 4 Mb RAM, 256 colour 640 x 480 monitor and card, CD drive, sound card.
Windows 95: 486 processor or faster (Pentium recommended), 4 Mb RAM, 256 colour 640 x 480 monitor and card, CD drive, sound card.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓												

Year Recommended in Grade Collection: 1999

Supplier: *Diffusion Dimédia*
539 boulevard Lebeau
Ville Saint-Laurent, QC H4N 1S2

Tel: (514) 336-3941 **Fax:** (514) 331-3916

Price: Single User $39.95
5-User Labpack $160.00
10-User Labpack $280.00

ISBN/Order No: Not available

Copyright: 1997

Adventures in Flight

Author(s): Seidman, Susan

General Description:

CD-ROM for Macintosh or Windows with accompanying teacher's resource binder is an open-ended program supporting several mathematical concepts. Using an airport setting, students explore demonstrations and solve problems related to five areas of airport operation. Graphics, photos, sound effects and animation, in an interactive design, encourage understanding. Teachers can track student progress. Includes blackline masters.

System Requirements:
Macintosh: LC III or later; 13" colour monitor set at 256 colours (8 bit); minimum 4 Mb RAM (5 Mb or more recommended); System 6.0.7 or later; printer recommended; CD-ROM drive. Windows: 386DX or later; Windows 3.1; Super VGA (640x480, 256 colours); minimum 4 Mb RAM (8 Mb recommended); Virtual Memory must be turned on; "Arial" TrueType font; mouse; SoundBlaster compatible sound card; CD-Audio and Sound drives compatible with MPC standards; speakers; printer recommended.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
					✓							

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: $73.72

ISBN/Order No: 0-201-82202-6/82201

Copyright: 1995

Architek (English Version)

Author(s): Lyons, M.; Lyons, R.

General Description:

Game that develops motor, perception and intellectual skills, consists of 18 blocks of various geometric shapes and a set of 90 problem cards. Students learn to recognize and name solids and explore the concepts of angles, proportion, similarity and force. The 120 problems are in varying levels of difficulty. Includes instruction booklet with answers.

Audience: General
ESL - visual focus
Gifted - varying degrees of difficulty; facilitates higher-level thinking skills

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓	✓	✓	✓									

Year Recommended in Grade Collection: 1999

Supplier: *Chenelière/McGraw-Hill*
7001, boulevard Saint-Laurent
Montréal, QC H2S 3E3

Tel: (514) 273-1066 **Fax:** (514) 276-0324

Toll Free: 1-800-565-5531

Web Address: www.dlcmcgrawhill.ca

Price: $39.94

ISBN/Order No: 289114533X

Copyright: 1993

Data Explorer (Version 1.1 for Macintosh and Windows)

General Description:

This resource is a very useful tool for collecting and representing data in graphs. Students create and administer surveys, either on paper or on the computer; input the data, if collected on paper and then manipulate it to create graphic representations. An electronic notebook allows students to complete an analysis on-screen. The program supports line plots, with icon choices, bar graphs, histograms, broken line graphs, box and whisker plots, stem and leaf plots, scatter plots, Venn diagrams, circle graphs and tables. The teacher support material includes a reference section that provides explanations of the functions of the program. The program often chooses axes that do not start at 0. This can be adjusted in some of the types of graphs.

System Requirements:
Macintosh: System 7.0 or higher, 68040 processor or better, 33 MHz, 3.5 Mb RAM, 256 colour 640 x 480 monitor.
Windows 3.1: Windows 3.1 or higher, 386 processor or better, 256 colour 640 x 480 monitor.
Windows 95: Windows 95 or higher, 486 processor or better (Pentium recommended), 256 colour 640 x 480 monitor.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
				✓	✓	✓						

Year Recommended in Grade Collection: 1999

Supplier: *Gage Educational Publishing Co.*
7554 Haszard Street
Burnaby, BC V5E 3X1

Tel: (604) 983-0922 **Fax:**

Price: $119.95

ISBN/Order No: Not available

Copyright: 1998

Dealing with Data: Probability and Sampling

Author(s): Montesanto, R.

General Description:

Resource provides a problem-solving step-by-step approach to probability and sampling. A series of investigations focus on discovering probability, using sample data in decision making, using probability and sampling. Activities are suitable for group and project work.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Nelson Thomson Learning*
1120 Birchmount Road
Scarborough, ON M1K 5G4

Tel: (416) 752-9448 **Fax:** (416) 752-8101

Toll Free: 1-800-268-2222/1-800-668-0671

Web Address: www.nelson.com

Price: $29.45

ISBN/Order No: 0669954772

Copyright: 1996

The Geoboard Portfolio

Author(s): Lashmar, P.; Lessard, P.

General Description:

Resource package presents a series of problem-solving activities using 5x5 pin geoboards. Laminated activity cards focus on squares, triangles, rectangles and other polygons, perimeter and area, motion geometry, symmetry and fractions. Supports cooperative learning and journal writing. The accompanying activity booklet has teaching notes and selected answers, along with an assessment organizer that includes tracking activities, student conference organizers, self-assessment instruments, generic organizers and journal suggestions. Geoboards must be purchased separately.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
					✓	✓	✓					

Year Recommended in Grade Collection: 1999

Supplier: *Spectrum Educational Supplies Ltd.*
125 Mary St.
Aurora, ON L4G 1G3

Tel: (905) 841-0600 **Fax:** (905) 727-6265

Toll Free: 1-800-668-0600

Price: $31.15

ISBN/Order No: 1895165644/22003

Copyright: 1994

The Geometer's Sketchpad Version 4

General Description:

Construction and exploration tool models geometry in two linked views, sketches and scripts. Sketches depict concrete geometry and emphasize spatial reasoning, while scripts describe constructions verbally and abstractly. The program allows for the construction, labelling, measurement and manipulation of any geometric figure, as well as the exploration of geometry concepts taught in Grades 7 through 11. The *Sketchpad Resource Centre* website, www.keypress.com/sketchpad, provides technical support and an online activity guide.

Optional activity modules are *Exploring Geometry with The Geometer's Sketchpad* and *Geometry Activities for Middle School Students with The Geometer's Sketchpad*. *Exploring Geometry* includes reproducible blackline masters plus a Windows/Macintosh CD-ROM with over 100 sketches and scripts that accompany the activities. *Geometry Activities for Middle School* consists of blackline activity masters that begin with a introductory tour of the basics of the program followed by geometry explorations. The CD-ROM includes all of the student sketches and teacher demonstrations.

System Requirements:
Macintosh: minimum of PowerPC-based system or equivalent; Mac OS 8.6 or later; 16 Mb RAM; CD-ROM drive
Windows : Pentium-based system or equivalent; Windows 95 or NT 4.0 or later; 16 Mb Ram; CD-ROM drive

Cautions:

The system defaults to inches, but it can be set to centimetres.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 2000

Supplier: *Spectrum Educational Supplies Ltd.*
2102 Elspeth Place
Port Coquitlam, BC V3C 1G3

Tel: (604) 942-5835 **Fax:** (604) 941-1066

Price: $694.95 10-User Lab Pack
$1,494.95 50-User School Site License
$65.95 Exploring Geometry
$65.95 Geometry Activities for Middle School

ISBN/Order No: 68600 10-User Lab Pac
68602 50-User School Site License
73434 Exploring Geometry
73430 Geometry Activities for Middle School

Copyright: 2001

Geometry Blaster

General Description:

CD-ROM package for Macintosh or Windows includes lessons, activities and games, all of which teach and reinforce geometric concepts. It uses a three-level approach, allowing a student to progress at a beginning, an intermediate or a mastery level. The main topics explored are points and lines, triangles, polygons and quadrilaterals, similarity, circles, perimeter and area, solids in 3D, coordinate geometry, transformational geometry and logical reasoning and proof. Requires decision making and creative thinking by students.

System Requirements:
Macintosh: System 7.0 or later, 8 Mb RAM.
Windows 3.1: 386/33 MHz, 8 Mb RAM, Pentium processor recommended, 256 super VGA or better colour monitor, sound and graphics cards, CD-ROM drive, and a mouse required; printer is recommended.
Windows 95: 486/50 MHz, 8 Mb RAM, Pentium processor recommended, 256 super VGA or better colour monitor, sound and graphics cards, CD-ROM drive, and a mouse required; printer is recommended.

Cautions:

Minimal emphasis real-life problem solving.
The games assume knowledge beyond the Grade 7 level and many parts of the resource are beyond the Grade 9 level.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Davidson & Associates, Inc.*
19840 Pioneer Avenue
P.O. Box 2961
Torrance, CA 90503

Tel: (310) 793-0600 **Fax:** (310) 793-0601

Toll Free: 1-800- 545-7677

Price: $79.95

ISBN/Order No: 0-7849-1063-4

Copyright: 1996

Geometry Grade 2

Author(s): Confer, Chris

General Description:

Book provides a complete unit of instruction to help students construct their own understanding of the properties of shapes, how shapes relate to one another and what happens when shapes are combined or divided. Students develop spatial understanding through problem solving. Includes information on lessons, assessment and homework. Only addresses 2-D shapes.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
		✓										

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: $32.60

ISBN/Order No: 0-201-87208-0/87208

Copyright: 1994

The Graph Club

General Description:

Integrated resource is designed to help students read and interpret graphs, use graphs to communicate information, answer questions and solve problems. It assists students in making the transition from graphing with manipulatives to graphing in the abstract and helps them understand the relationship between different representations of the same data. Encourages problem solving, cooperative learning and cross-curricular integration. Includes classroom tips and activities, sample graphs, blackline masters and software choices. Package can stand alone without software.

System Requirements:
Macintosh: Macintosh Classic, System 7.0 or later, 4 Mb RAM.
Windows: Windows 3.1 or Windows '95, 386 or 486, 4 Mb RAM, sound card, VGA monitor, mouse.

Cautions:

There is no sort command to allow for changing display format and automatic sorting of data.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓	✓	✓	✓									

Year Recommended in Grade Collection: 1999

Supplier: *TORCOMP Systems Ltd.*
7070 Pacific Circle
Mississauga, ON L5T 2A7

Tel: (905) 564-7272 **Fax:** (905) 564-1377

Toll Free: 1-800-561-7520

Web Address: www.torcomp.com

Price: $119.95 each version

ISBN/Order No: Not available

Copyright: 1995

Graphers

General Description:

Graphing tool allows the user to collect, organize and display data in various forms of charts and graphs appropriate to grade level. It also allows for communicating information about the data in an on-screen notebook. This program features a variety of topics, complete with icons; a split screen to view more than one chart and/or graph; a work space where students can manipulate data and a teacher's option feature that allows teachers to select graphs according to a student's grade level. The teacher guide provides sample lessons by grade level, step-by-step instructions on how to use the program and a set of blackline masters.

System Requirements:
Macintosh: System 6.0.7 or higher, 68020 processor or higher, 2 Mb RAM.
Windows 3.1: Windows 3.1 or higher, 2 Mb RAM.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓	✓	✓	✓	✓								

Year Recommended in Grade Collection: 1999

Supplier: *Gage Educational Publishing Co.*
7554 Haszard Street
Burnaby, BC V5E 3X1

Tel: (604) 983-0922 **Fax:**

Price: $99.95

ISBN/Order No: Not available

Copyright: 1997

Hot Dog Stand: The Works

General Description:

This software for Macintosh or Windows simulates running a hot dog stand. Students gather information, keep records, plan inventory, decide on pricing and look at selling strategies. There are three levels of operation. At the intermediate and advanced levels, students also deal with the unexpected events of running a business, such as weather, unreliable suppliers and machine breakdown. Students estimate, calculate, read graphs and keep track of their progress in a journal - incorporated as a mini-word processor. The accompanying teacher's guide provides follow-up activities related to starting and running a business.

System Requirements:
Macintosh: System 7.0 or later; 68040 or later processor; 8 Mb RAM; 31 Mb hard drive space; double speed CD-ROM drive; and 640 x 480 256 colour monitor.
Windows: Windows 3.1 or Windows 95, 8 Mb RAM, 30 Mb hard drive, double speed CD-ROM drive, 640 x 480 256 colour monitor.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
				✓	✓	✓	✓					

Year Recommended in Grade Collection: 1999

Supplier: *Gage Educational Publishing Co. (Scarborough)*
164 Commander Boulevard
Scarborough, ON M1S 3C7

Tel: (416) 293-8464 ext. **Fax:** (416) 293-9009

Toll Free: 1-800-667-1115

Web Address: www.gagelearning.com

Price: $89.95 each version

ISBN/Order No: Not available

Copyright: 1996

Interactions (Level Kindergarten)

Author(s): Hope, J.; Small, M.

General Description:

Activity-based program stimulates mathematical thinking, and helps students become flexible problem solvers and develop positive attitudes toward math. The package comprises a teacher's resource binder with blackline masters and a math literature pack with one big book, seven read together books, fourteen small books and two audio cassettes.

Cautions:

In the math literature pack, one story relates to a wizard and magic.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓												

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Teacher's Resource Binder: $102.47
Math Literature Pack: $208.00

ISBN/Order No: Teacher's Resource Binder: 0770223052
Math Literature Pack: 999990131X

Copyright: 1994

Interactions (Level 1)

Author(s): Small, M. et al.

General Description:

Activity-based program stimulates mathematical thinking, and helps students become flexible problem solvers and develop positive attitudes toward math. The package comprises a teacher's resource binder, blackline masters, activity cards and booklets.

Cautions:

The special role of zero in addition is only mentioned in passing in the later parts of the resource and is taken for granted whenever addition and subtraction of two-digit numbers is done later in the series.
Measurement contexts are restricted in variety.
There is an inappropriate equating of mass with bigness, ignoring objects that are large in volume or area, but light in mass.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
	✓											

Year Recommended in Grade Collection: 1999

Supplier: *Irwin Publishing*
325 Humber College Blvd.
Toronto, ON M9W 7C3

Tel: (416) 798-0424 **Fax:** (416) 798-1384

Toll Free: 1-800-263-7824

Price: Teacher's Resource Binder $155.95
Blackline Masters $38.95
Activity Cards $42.95

ISBN/Order No: Teacher's Resource Binder 0770223125
Blackline Masters 077022489X
Activity Cards 0770223117

Copyright: 1995

Interactions (Level 2)

Author(s): Small, M. et al.

General Description:

Activity-based program stimulates mathematical thinking, and helps students become flexible problem solvers and develop positive attitudes toward math. The package comprises a teacher's resource binder, blackline masters, activity cards, eight booklets and a math literature pack with big books, small books and audio cassettes.

Cautions:

The treatment of shape and space has some extraneous material (such as standard units for mass) and some omissions (such as the decimetre)

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
		✓										

Year Recommended in Grade Collection: 1999

Supplier: *Irwin Publishing*
325 Humber College Blvd.
Toronto, ON M9W 7C3

Tel: (416) 798-0424 **Fax:** (416) 798-1384

Toll Free: 1-800-263-7824

Price: Teacher's Resource Binder: $155.95
Activity Cards: $42.95

ISBN/Order No: Teacher's Resource Binder: 07702-37509
Activity Cards: 0770223257

Copyright: 1994

Interactions (Level 3)

Author(s): Small, M. et al.

General Description:

Activity-based program stimulates mathematical thinking, and helps students become flexible problem solvers and develop positive attitudes toward math. The package comprises a student text, teacher's resource binder and blackline masters.

Cautions:

Activities on decimals and symmetry are extraneous.
The development of outcomes relating to vertical, horizontal and perpendicular lines, congruent objects and shapes and the use of vertical and horizontal lines needs to be supplemented.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
			✓									

Year Recommended in Grade Collection: 1999

Supplier: *Irwin Publishing*
325 Humber College Blvd.
Toronto, ON M9W 7C3

Tel: (416) 798-0424 **Fax:** (416) 798-1384

Toll Free: 1-800-263-7824

Price: Student Text: $28.95
Teacher's Resource Binder: $159.95
Masters: $43.95

ISBN/Order No: Student Text: 0770223389
Teacher's Resource Binder: 0770223397
Masters: 0770225403

Copyright: 1993

Interactions (Level 4)

Author(s): Hope, Jack; Small, Marion

General Description:

Activity-based math program helps children develop skills through number sense, spatial sense and problem solving. It is organized around topics of numeration, operations, data management, measurement and geometry. Components comprise a student book and a teacher's resource book. Glossary not included.

Audience: General
Gifted - extension activities

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
				✓								

Year Recommended in Grade Collection: 1999

Supplier: *Irwin Publishing*
325 Humber College Blvd.
Toronto, ON M9W 7C3

Tel: (416) 798-0424 **Fax:** (416) 798-1384

Toll Free: 1-800-263-7824

Price: Student Text: $29.95
Teacher's Resource Book: $159.95

ISBN/Order No: Student Text: 07702-2316
Teacher's Resource Book: 07702-23524

Copyright: 1997

Interactions (Level 5)

Author(s): Hope, Jack; Small, Marion

General Description:

Activity-based math program helps children develop skills through number sense, spatial sense and problem solving. It is organized around topics of numeration, operations, data management, measurement and geometry. Components comprise a student book and a teacher's resource book. Glossary not included.

Cautions:

Patterns are treated somewhat superficially.

Audience: General
Gifted - extension activities

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
					✓							

Year Recommended in Grade Collection: 1999

Supplier: *Irwin Publishing*
325 Humber College Blvd.
Toronto, ON M9W 7C3

Tel: (416) 798-0424 **Fax:** (416) 798-1384

Toll Free: 1-800-263-7824

Price: Student Text: $29.95
Teacher's Resource Book: $159.95

ISBN/Order No: Student Text: 07702-23648
Teacher's Resource Book: 07702-23656

Copyright: 1997

Interactions (Level 6)

Author(s): Hope, Jack; Small, Marion

General Description:

Activity-based math program helps children develop skills through number sense, spatial sense and problem solving. It is organized around topics of numeration, operations, data management, measurement and geometry. Components comprise a student book and a teacher's resource book. Glossary not included.

Cautions:

The Shape and Space organizer, in particular 3-D Objects and 2-D Shapes, needs supplementing

Audience: General
Gifted - extension activities

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
						✓						

Year Recommended in Grade Collection: 1999

Supplier: *Irwin Publishing*
325 Humber College Blvd.
Toronto, ON M9W 7C3

Tel: (416) 798-0424 **Fax:** (416) 798-1384

Toll Free: 1-800-263-7824

Price: Student Text: $22.60
Teacher's Resource Book: $185.40

ISBN/Order No: Student Text: 07702-23753
Teacher's Resource Book: 07702-23761

Copyright: 1997

Interactions (Level 7)

Author(s): Elchuk, L. et al.

General Description:

Resource package comprises a student text and teacher's resource book with accompanying assessment booklet and blackline masters. It provides opportunities to develop mathematical literacy along three dimensions: number sense, spatial sense and problem solving. Includes many learning activities. Requires manipulatives such as algebra tiles and integer discs, as well as suitable software. Glossary not included.

Cautions:

Supplementary material on geometrical transformations is necessary.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Irwin Publishing*
325 Humber College Blvd.
Toronto, ON M9W 7C3

Tel: (416) 798-0424 **Fax:** (416) 798-1384

Toll Free: 1-800-263-7824

Price: Student Textbook: $40.95
Teacher's Resource Binder: $160.95

ISBN/Order No: Text: 013258-7998
Teacher's Resource Book: 0132588072

Copyright: 1996

The Intermediate Geoboard

Author(s): Danbrook, C.; Lesage, J.

General Description:

This resource is designed to assist teachers in using the large geoboard with students in Grades 7 to 9. It contains teacher notes, student activity pages, and follow-up activities on how to use the 10x10 pin, 11x11 pin and linking geoboards. Topics include shapes, symmetry, similarity, congruency, area, perimeter, Pythagorean theorem, fractions, percent, Cartesian coordinates and analytic transformation. Provides blackline masters and answers for the activities. Geoboards are not included.

Audience: General

Category: Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓	✓	✓			

Year Recommended in Grade Collection: 1999

Supplier: *Exclusive Educational Products*
243 Saunders Road
Barrie, ON L4N 9A3

Tel: (705) 725-1166 **Fax:** (705) 725-1167

Toll Free: 1-800-563-1166

Web Address: www.exclusiveeducational.ca

Price: $31.46

ISBN/Order No: Not available

Copyright: 1996

Learn with "Matty" on the Calcu-Mat

General Description:

This resource contains a 132 cm by 152 cm vinyl calculator mat and a student guide. The activities are designed to introduce calculator skills through touching the keys on the mat.

Audience: General
ESL - resource lends itself to language development
LD - hands on tool

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓	✓											

Year Recommended in Grade Collection: 1999

Supplier: *Exclusive Educational Products (B.C.)*
3436 West 35th Avenue

Vancouver, BC V6N 2N2

Tel: (604) 266-2261 **Fax:** (604) 266-2287

Toll Free: 1-800-563-1166

Price: $44.95

ISBN/Order No: Not available

Copyright: 1993

The Learning Equation: Mathematics 7

General Description:

Interactive program for Macintosh or Windows consists of two CD-ROMs, a student refresher and a teacher's guide. All lessons follow the pattern of an introduction, followed by a tutorial example for students, a summary of concepts, practice problems, extra practice and a self check. Students are able to monitor their own progress through the various components of each lesson. Also included on the CD-ROMs is a glossary which students can access as a pull-down menu. The student refresher follows the organization of the CD-ROMs and provides additional examples for students as well as answers. The teacher's manual includes installation notes, instructional summaries, prerequisite skills, and cross-references to the CD-ROMs.

System Requirements:
Macintosh: System 7.1 or later, 8 Mb RAM (16 Mb preferred), VGA 256-colour 14" monitor, 15 Mb or more hard disk space, double speed CD-ROM drive, 8 bit sound support for audio.
Windows 3.1: MPC2 compliant computer, 486SX 25 MHz (50 or better preferred), 8 Mb RAM (16 Mb preferred), VGA 256-colour monitor, 40 Mb hard disk space, double speed CD-ROM drive, SoundBlaster or 100% support for audio.
Windows 95: MPC2 compliant computer, 486SX 66 MHz (Pentium preferred), 16 Mb RAM, VGA 256-colour monitor, 40 Mb hard disk space, double speed CD-ROM drive, SoundBlaster or 100% support for audio.
Windows 98 or NT: MPC2 compliant computer, Pentium 100 MHz (Pentium 133 or faster recommended), 16 Mb or more RAM, VGA 256 colour monitor, 40 Mb or more of free hard disk space, double speed CD drive or better, SoundBlaster or 100% support for audio.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Nelson Thomson Learning*
1120 Birchmount Road
Scarborough, ON M1K 5G4

Tel: (416) 752-9448 **Fax:** (416) 752-8101

Toll Free: 1-800-268-2222/1-800-668-0671

Web Address: www.nelson.com

Price: CD-ROMs 1 and 2, Version 2.0 - $150.00
Student Refresher - $10.95
Teacher's Manual - $87.95

ISBN/Order No: CD-ROMs 1 and 2, Version 2.0 - 0176155635
Student Refresher - 0176156526
Teacher's Manual - 0176156798

Copyright: 1999

Math Discoveries: Grades K-1

General Description:

Three booklets are designed to help students understand concepts through hands-on activities, using geoboards, pattern blocks and tangrams. Provides some problem solving and group work ideas. Includes reproducible student activities, extensions, investigations, teacher notes and sample solutions. Manipulatives are not included with the booklets.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓	✓											

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Each book: $11.60

ISBN/Order No: Math Discoveries with Geoboards: Grades K-1: 1564510867
Math Discoveries with Pattern Blocks: Grades K-1: 1564510883
Math Discoveries with Tangrams: Grades K-1: 1564510891

Copyright: 1994

Math Discoveries: Grades 1-3

General Description:

Three booklets are designed to help students understand concepts through hands-on activities, using attribute blocks, base ten blocks and pentominoes. Provides some problem solving and group work ideas. Includes reproducible student activities and investigations, extensions, teacher notes and sample solutions. Manipulatives are not included with the booklets.

Cautions:

The reading level in *Attribute Blocks* and *Base Ten Blocks* may be too difficult for some students.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
	✓	✓	✓									

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Each book: $11.60

ISBN/Order No: Math Discoveries with Attribute Blocks: Grades 1-3: 156451076X
Math Discoveries with Base Ten Blocks: Grades 1-3: 1564510786
Math Discoveries with Pentominoes: Grades 1-3: 1564501650

Copyright: 1995

Math Discoveries: Grades 2-3

General Description:

Three booklets are designed to help students understand concepts through hands-on activities, using geoboards, pattern blocks and tangrams. Provides some problem solving and group work ideas. Includes reproducible student activities, extensions, investigations, teacher notes and sample solutions. Manipulatives are not included with the booklets.

Cautions:

Pattern blocks are limited.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
		✓	✓									

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Each book: $11.60

ISBN/Order No: Math Discoveries with Geoboards: Grades 2-3: 1564510778
Math Discoveries with Pattern Blocks: Grades 2-3: 1564510743
Math Discoveries with Tangrams: Grades 2-3: 1564510751

Copyright: 1994

Math Discoveries: Grades 3-4

General Description:

Four booklets are designed to help students understand concepts through hands-on activities, using a variety of manipulatives. Provides some problem solving and group work ideas. Includes reproducible student explorations and investigations, extensions, teacher notes and sample solutions. Manipulatives are not included with the booklets.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
			✓	✓								

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Each book: $11.60

ISBN/Order No: Various

Copyright: 1996

Math Discoveries: Grades 5-6

General Description:

Five booklets are designed to help students understand concepts through hands-on activities using a variety of manipulatives. Provides problem solving and group work ideas. Includes reproducible student explorations and investigations, extensions, teacher notes and sample solutions. Some American spelling and references to Imperial measure. Teachers will need to supplement process of estimation. Calculators are used in some activities. Manipulatives are not included with the booklets.

Cautions:

American spelling and and use of Imperial measure noted.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
					✓	✓						

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Each book: $11.60

ISBN/Order No: Various

Copyright: 1996

Math Tools

General Description:

This package is a set of Windows software utilities that can share data. The tools include spreadsheet, calculation, geometry, graphs, manipulatives, fraction strips and probability. A colour linking feature between two or more windows allows data to be shared and represented in a variety of formats. Includes information on installing and using the software and chapters specific to each math tool. Provides a glossary and index.

System Requirements:
Windows 3.1: 386/33 MHz, 4 Mb of RAM, 13" VGA monitor, 2 Mb hard disk space, PKZIP.
Windows 95: 486/50 MHz, 8 Mb of RAM, 13" VGA monitor, 2 Mb hard disk space, PKZIP.

Cautions:

The algebra tile manipulatives have limited usage (first-degree variables only.) The spreadsheet uses radians as units for sine, cosine and tangent calculations.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
				✓	✓	✓	✓					

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: $58.94

ISBN/Order No: 0134109783

Copyright: 1997

MATHPOWER 7, Western Edition

Author(s): Knill, G.

General Description:

Student book, teacher's edition, and blackline masters support the learning of mathematics in various ways. They present concepts and skills in problem-solving contexts. Questions help students express their ideas about math orally and in writing. Uses manipulatives for the understanding of abstract concepts and integrates appropriate technology throughout. The Teacher's Edition contains lesson plans, strategies for reinforcement, extension, enrichment and assessment and masters for materials such as grid and dot paper, number lines, algebra tiles, tangrams, spinners, geometric shapes and nets.

Cautions:

There is insufficient emphasis on estimation and mental mathematics for some students.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *McGraw-Hill Ryerson Ltd. (Ontario)*
300 Water Street
Whitby, ON L1N 9B6

Tel: (905) 430-5000 **Fax:** (905) 430-5020

Toll Free: 1-800-565-5758 (orders)

Web Address: www.mcgrawhill.ca

Price: Student Book: $33.00
Teacher's Edition: $105.00
Blackline Masters: $89.25

ISBN/Order No: Student Book: 0075526476
Teacher's Edition: 0075526492
Blackline Masters: 0075526484

Copyright: 1996

Mathville Mindway

General Description:

Software for Macintosh or Windows provides a virtual midway where traditional games of skill and chance are transformed into mathematics activities. There are eight games on the Mindway and students are free to explore any of the games and to choose difficulty levels within each game. Students use problem solving skills related to the four strands of the mathematics program. The activities are engaging and have visual appeal for students.

System Requirements:
Macintosh: System 7 or higher, 8 Mb RAM, 640x480 256 colour monitor, CD drive, sound card.
Windows 3.1: 486/50 MHz, 8 Mb RAM, SVGA 640x480 256 colour monitor, CD drive, sound card.
Windows 95: 486/66 MHz (Pentium 100 MHz recommended), 8 Mb RAM, SVGA 640x480 256 colour monitor, CD drive, sound card.

Cautions:

In the "Magic Doors" game, the doors close very quickly and there may not be sufficient time for students to process information. This resource could be problematic for students with poor hand-eye coordination.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
			✓	✓	✓							

Year Recommended in Grade Collection: 1999

Supplier: *Ingenuity Works*
101, 3738 N Fraser Way
Burnaby, BC V5J 5K8

Tel: (604) 412-1555 **Fax:** (604) 299-2428

Toll Free: 1-800-665-0667

Price: $56.00

ISBN/Order No: Not available

Copyright: 1996

Mathville VIP

General Description:

Interactive CD-ROM for Macintosh or Windows integrates a broad range of thinking and mathematical skills with everyday life in the multimedia environment of a virtual village. In Mathville each student becomes a Very Important Person by walking, shopping and playing related to the four strands of the mathematics program. Activities are imaginative and engaging for students. The program is flexible and non-competitive and supports different levels of student learning. It is suitable for review at the Grades 7 to 8 levels and for enrichment at Grade 6, using problem-solving skills.

System Requirements:
Macintosh: System 7 or higher, 640x480 colour monitor, 8 Mb hard disk space, CD-ROM drive.
Windows 3.1: 486/50 MHz, 8 Mb RAM, colour monitor, sound and graphics cards, mouse, CD-ROM drive.
Windows 95: 486/66 MHz, 8 Mb RAM, colour monitor, sound and graphics cards, mouse, CD-ROM drive.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
						✓	✓					

Year Recommended in Grade Collection: 1999

Supplier: *Courseware Solutions Inc.*
205 - 99 Hayden Street
Toronto, ON M4Y 3B4

Tel: (416) 925-0234 **Fax:** (416) 925-0234

Web Address: www.mathville.com

Price: $56.00

ISBN/Order No: 1-89569154-0

Copyright: 1996

Mathworks: Book A

Author(s): Kelleher, H.

General Description:

Activity-based mathematics program comprising a teacher's resource book, blackline masters and two gameboards, builds on the student's world of experience and interests. Focusses on mathematical thinking, reasoning and problem solving, and provides for on-going assessment and evaluation to support diagnostic teaching. Nine units provide theme-based topics.

Cautions:

The development of the following concepts need to be supplemented:
-addition and subtraction concepts to 18. The resource covers addition and subtraction to 12.
-concepts on temperature using the sense
-concepts on describing relative position of 3-D objects and 2-D shapes
-concepts on exploring and describing reflection in a mirror
-vocabulary describing statistics and probability (i.e., never, sometimes, always)

Audience: General
Gifted - extension activities; promotes reasoning skills
ID (Mild) - provides opportunities for reinforcement

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
	✓											

Year Recommended in Grade Collection: 1999

Supplier: *Nelson Thomson Learning*
1120 Birchmount Road
Scarborough, ON M1K 5G4

Tel: (416) 752-9448 **Fax:** (416) 752-8101

Toll Free: 1-800-268-2222/1-800-668-0671

Web Address: www.nelson.com

Price: Teacher's Resource Book: $381.45

ISBN/Order No: Teacher's Resource Book: 0395587913

Copyright: 1992

Mighty Math Carnival Countdown (Macintosh / Windows School Version)

General Description:

Two CD-ROMs for Macintosh and Windows provide five easy-to-use activities on a carnival theme that focus on one- and two-digit addition and subtraction, 2D geometry, patterns, equivalencies, logic, attributes and early multiplication and division. Levelling of activities is easy to access and pre-program for students. The teacher resource manual is user-friendly.

System Requirements:
Macintosh: System 7.0.1 or higher; 68040, 68030 (25 MHz or faster recommended) or PowerPC; 4 Mb RAM (8 Mb recommended); 256 colour, 13-inch or larger monitor; double speed CD drive.
Windows 3.1: 486 (Pentium recommended), hard disk with up to 5 Mb free, 8 Mb RAM, Super VGA graphics, 256 colour 640 x 480 monitor, double speed CD drive, Windows-compatible sound card.
Windows 95: 486 (Pentium recommended), hard disk with up to 5 Mb free, 8 Mb RAM, Super VGA graphics, 256 colour 640 x 480 monitor, double speed CD drive, Windows-compatible sound card.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓	✓	✓										

Year Recommended in Grade Collection: 1999

Supplier: *Edmark Corporation*
P.O. Box 3218
6727 185th Avenue North East
Redmond, WA 98073-3218

Tel: (425) 556-8400 **Fax:** (425) 556-8430

Toll Free: (800) 426-0856 ex. 8436

Price: $59.95

ISBN/Order No: 1569262810

Copyright: 1996

Minds on Math 7, Revised Edition

Author(s): Alexander, R.

General Description:

Book provides activities, instruction, discussion, exercises, and projects to engage students in meaningful, real-world mathematics. Each chapter begins with activities and exercises that allow students to assess their prior knowledge before they explore new concepts. Includes teacher's resource book, template and data disk package and activity cards with answer key. Manipulatives such as algebra tiles, integer discs, and suitable software are necessary for using the resource effectively; these are not supplied with the resource. The software package requires either Claris Works or Microsoft Works.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Student Text: $34.92
Teacher's Resource Book: $111.25
Activity Cards with Answer Key: $66.75

ISBN/Order No: Student Text: 0201426803
Teacher's Resource Book: 0201426838
Activity Cards with Answer Key: $66.75

Copyright: 1996

Mirror Symmetry

General Description:

CD-ROM for Macintosh or Windows allows for an extensive exploration of symmetry and related concepts. It includes a wide range of learning activities that span simple to complex applications. The resource promotes independent learning, critical thinking, and connections to real-world situations, and encourages mathematical communication oral and written. Teacher support materials include a teacher guide that has many extension and assessment tasks and a computer component that provides flexible class management options.

System Requirements:
Macintosh: System 7.1 or higher, Macintosh LC II or higher (25 MHz 68030 processor or better), 8 Mb RAM (5 Mb available), 256 colour 13-inch monitor, double speed CD drive, approximately 14 Mb free hard disk space, microphone (built-in or external).
Windows 3.1: 486/DX2-66 MHz (Pentium recommended), 8 Mb installed RAM, SVGA 256 colour compatible video card and monitor, double speed CD drive, approximately 12 Mb free hard disk space, microphone (built-in or external), SoundBlaster card or equivalent, mouse.
Windows 95: 486/DX2-66 MHz (Pentium recommended), 8 Mb installed RAM, SVGA 256 colour compatible video card and monitor, double speed CD drive, approximately 12 Mb free hard disk space, microphone (built-in or external), SoundBlaster card or equivalent, mouse.

Audience: General
ESL - provides opportunities for a wide range of student learning needs
Gifted - provides opportunities for a wide range of student learning needs
LD - provides opportunities for a wide range of student learning needs
ID (Mild) - provides opportunities for a wide range of student learning needs

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
		✓	✓	✓	✓	✓	✓					

Year Recommended in Grade Collection: 1999

Supplier: *McIntyre Media Ltd.*
75 First St., Suite 203
Orangeville, ON L9W 5B6

Tel: (519) 942-9640 **Fax:** (519) 942-8489

Toll Free: 1-800-565-3036

Web Address: www.mcintyre.ca

Price: $99.95

ISBN/Order No: 188861868X

Copyright: 1998

Mosaic Magic: A Toy, Creativity Tool, and Math Teacher All in One

General Description:

Macintosh software package and teacher resource binder allows students to work with tiles on the computer screen in order to recognize patterns, practise reasoning, and classify and locate objects on a grid. Included are project ideas and twenty-three lesson plans containing worksheets and answers.

System Requirements: Macintosh Plus or later; System 6.05 or later.

Cautions:

The friendly bear character providing feedback to responses may be too juvenile for upper elementary students.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
	✓	✓	✓	✓	✓	✓						

Year Recommended in Grade Collection: 1999

Supplier: *Westworld Computers Limited*
10333 - 170 Street
Edmonton, AB T5P 4V4

Tel: (780) 454-5190 **Fax:** 1-800-929-5630

Toll Free: 1-888-622-4280

Price: $68.00 (Single User)

ISBN/Order No: 0789832046

Copyright: 1997

Numbers and Patterns: Investigating Rate, Ratio, and Proportion

Author(s): Montesanto, R.

General Description:

Student text and teacher's guide provide inquiry-based hands-on activities to develop an understanding of numbers and patterns. A series of investigations focus on rate, ratio, proportion, and their use. Guide includes teaching notes, lesson plans, blackline masters and answers.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Nelson Thomson Learning*
1120 Birchmount Road
Scarborough, ON M1K 5G4

Tel: (416) 752-9448 **Fax:** (416) 752-8101

Toll Free: 1-800-268-2222/1-800-668-0671

Web Address: www.nelson.com

Price: Text: $17.65
Teacher's Guide: $24.95

ISBN/Order No: Text: 0669954764
Teacher's Guide: 0669954801

Copyright: 1995

Pre-Algebra Math Blaster Mystery: The Great Brain Robbery - Teacher's Edition

General Description:

This CD-ROM for Windows builds pre-algebra, logical-thinking and problem-solving skills. As students explore the mansion and laboratory of Dr. Dabble, they learn to solve word problems using computations, estimates and proportions; compute with whole numbers, fractions, decimals, integers and rational numbers; apply ratios, proportions and percents; translate mathematical expressions; apply order of operation skills; manipulate positive and negative numbers; create mathematical equations and think logically. The resource has three levels of difficulty and students may choose one of two ways to play: solving the mystery, or playing individual activities. It includes digitized sound effects, music and speech, record-keeping scoreboards and on-line tips for parents. A four-function calculator is always available on the screen.

System Requirements:
Windows 3.1: 486/25 MHz, 4 Mb RAM, Windows-compatible sound accessory, VGA or SVGA card (with 640 x 480 resolution), CD drive (double speed or faster), printer (optional).
Windows 95: 486/50 MHz, 8 Mb RAM, Windows-compatible sound accessory, VGA or SVGA card (with 640 x 480 resolution), CD drive (double speed or faster), printer (optional).

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Davidson & Associates, Inc.*
19840 Pioneer Avenue
P.O. Box 2961
Torrance, CA 90503

Tel: (310) 793-0600 **Fax:** (310) 793-0601

Toll Free: 1-800- 545-7677

Price: $79.95

ISBN/Order No: 0784904200

Copyright: 1994

Quest 2000: Exploring Mathematics (Grade K)

Author(s): Wortzman, R. et al.

General Description:

Program stimulates students to use mathematics to solve problems, to communicate their mathematical thinking, and to build a lifelong appreciation of and ability to use mathematics in everyday life. Resource package comprises a teacher's guide and journal, student booklets, answer key, transparencies, activity and assessment masters, posters, class journal and a professional handbook. The focus is on engaging students in meaningful activities to build a community of learners; connecting mathematical experiences with other subjects and to the real world; encouraging communication through questioning and reflection about mathematical ideas; and involving families. Assessment is linked to instruction. It presents eight units built around key mathematical ideas with a chart outlining essential understandings, benchmarks, and pacing that summarizes the concepts covered at each grade level. Technology suggestions are included.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓												

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Teacher's Guide: $120.05

ISBN/Order No: Teacher's Guide and Journal: 0201828545

Copyright: 1995

Quest 2000: Exploring Mathematics (Grade 1)

Author(s): Wortzman, R. et al.

General Description:

Program stimulates students to use mathematics to solve problems, to communicate their mathematical thinking, and to build a lifelong appreciation of and ability to use mathematics in everyday life. Resource package comprises a student book, teacher's guide and journal, extra practice and testing masters, teacher support package, problem of the week transparencies, estimation and mental math activities, activity cards for exploration centres and a professional handbook. The focus is on engaging students in meaningful activities to build a community of learners; connecting mathematical experiences with other subjects and to the real world; encouraging communication through questioning and reflection about mathematical ideas; and involving families. Assessment is linked to instruction. It presents eight units built around key mathematical ideas with a chart outlining essential understandings, benchmarks, and pacing that summarizes the concepts covered at each grade level. Technology suggestions are included.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
	✓											

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Student Book: $10.50
Teacher's Guide and Journal: $105.95

ISBN/Order No: Student Book: 0201552612
Teacher's Guide and Journal: 0201552604

Copyright: 1995

Quest 2000: Exploring Mathematics (Grade 2)

Author(s): Wortzman, R. et al.

General Description:

Program stimulates students to use mathematics to solve problems, to communicate their mathematical thinking, and to build a lifelong appreciation of and ability to use mathematics in everyday life. Resource package comprises a student book, teacher's guide and journal, blackline masters, teacher support package, problem of the week transparencies, estimation and mental math activities, activity cards for exploration centres and a professional handbook. The focus is on engaging students in meaningful activities to build a community of learners, connecting mathematical experiences with other subjects and to the real world, encouraging communication through questioning and reflection about mathematical ideas and involving families. Assessment is linked to instruction.

Cautions:

Outcomes related to measurement should be supplemented.
Images of coins on the blackline masters are of poor quality.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
		✓										

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Student Book: $10.50
Teacher's Guide and Journal: $105.95

ISBN/Order No: Student Book: 0201552639
Teacher's Guide and Journal: 0201552647

Copyright: 1996

Quest 2000: Exploring Mathematics (Grade 3)

Author(s): Wortzman, R. et al.

General Description:

Program stimulates students to use mathematics to solve problems, to communicate their mathematical thinking, and to build a lifelong appreciation of and ability to use mathematics in everyday life. Resource package comprises a student book, teacher's guide and journal, practice masters, teacher support package, technology package, problem of the week transparencies, estimation and mental math activities, activity cards for exploration centres and a professional handbook. Focus is on activities.

System Requirements:
Macintosh: System 6.0.5 or higher, 4 Mb RAM, mouse, either ClarisWorks v2.0 or later, or Microsoft Works v3.0 or later.
Windows 3.1: 386/33 MHz, 4 Mb RAM, mouse, either ClarisWorks v1.0 or later, or Microsoft Works v3.0 or later.
Windows 95: 486/50 MHz, 8 Mb RAM, mouse, either ClarisWorks v1.0 or later, or Microsoft Works v3.0 or later.

Cautions:

Outcomes related to measurement should be supplemented.
Images of coins on the blackline masters are of poor quality.
The concepts related to the metric system of measurement are embedded in the student tasks and not made explicit.
Software package requires considerable preparation before use.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
			✓									

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Student Book: $22.20
Teacher's Guide: $105.95

ISBN/Order No: Student Book: 0201552663
Teacher's Guide and Journal: 0201552671

Copyright: 1996

Quest 2000: Exploring Mathematics (Grade 4)

General Description:

Program stimulates students to use mathematics to solve problems, to communicate their mathematical thinking, and to build a lifelong appreciation of and ability to use mathematics in everyday life. Resource package comprises a student book, a teacher's guide and journal, solutions manual, practice and testing masters, teacher support package, technology package, problem of the week transparencies, estimation and mental math activities, activity cards for exploration centres and a professional handbook. It focuses on engaging students in meaningful activities to build a community of learners, connecting mathematical experiences with other subjects and to the real world, encouraging communication through questioning and reflection about mathematical ideas, and involving families. Assessment is linked to instruction. Eleven units are built around key mathematical ideas, with a chart outlining essential understandings, benchmarks and pacing that summarizes the concepts taught at each grade level. Technology suggestions are included.

System Requirements:
Macintosh: System 6.0.5 or later, 4 Mb RAM, mouse, either ClarisWorks v2.0 or later, or Microsoft Works v3.0 or later.
Windows 3.1: 386/33 MHz, 4 Mb RAM, mouse, either ClarisWorks v1.0 or later, or Microsoft Works v3.0 or later.
Windows 95: 486/50 MHz, 8 Mb RAM, mouse, either ClarisWorks v1.0 or later, or Microsoft Works v3.0 or later.

Cautions:

Software package requires considerable preparation before use.
Money problems go to $25 not $50.
There is some extraneous material on fractions in Unit 6.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
				✓								

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Student Book: $21.95
Teacher's Guide and Journal: $99.95

ISBN/Order No: Student Book: 0-201-55269-8
Teacher's Guide and Journal: 0-201-681293

Copyright: 1997

Quest 2000: Exploring Mathematics (Grade 5)

General Description:

Program stimulates students to use mathematics to solve problems, to communicate their mathematical thinking, and to build a lifelong appreciation of and ability to use mathematics in everyday life. Resource package comprises a student book, a teacher's guide and a journal, solutions manual, practice and testing masters, teacher support package, technology package, problem of the week transparencies, estimation and mental math activities, activity cards for exploration centres and a professional handbook. It focuses on engaging students in meaningful activities to build a community of learners, connecting mathematical experiences with other subjects and to the real world, encouraging communication through questioning and reflection about mathematical ideas, and involving families. Assessment is linked to instruction. Eleven units are built around key mathematical ideas, with a chart outlining essential understandings, benchmarks and pacing that summarizes the concepts taught at each grade level. Technology suggestions are included.

System Requirements:
Macintosh: System 6.0.5 or later, 4 Mb RAM, mouse, either ClarisWorks v2.0 or later, or Microsoft Works v3.0 or later.
Windows 3.1: 386/33 MHz, 4 Mb RAM, mouse, either ClarisWorks v1.0 or later, or Microsoft Works v3.0 or later.
Windows 95: 486/50 MHz, 8 Mb RAM, mouse, either ClarisWorks v1.0 or later, or Microsoft Works v3.0 or later.

Cautions:

Outcomes related to the measurement of mass and time and 3-D drawings need to be supplemented.
Mixed numbers and stem-and-leaf plots are extraneous to Grade 5.
Ordered pairs, such as (4,3), are introduced in the context of graphing patterns.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
					✓							

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Student Book: $21.95
Teacher's Guide & Journal: $99.95

ISBN/Order No: Student Book: 0-201-55272-8
Teacher's Guide & Journal: 0-201-55273-6

Copyright: 1996

Quest 2000: Exploring Mathematics (Grade 6)

General Description:

Program stimulates students to use mathematics to solve problems, to communicate their mathematical thinking, and to build a lifelong appreciation of and ability to use mathematics in everyday life. Resource package comprises a student book, a teacher's guide and journal, a solutions manual, practice and testing masters, teacher support package, technology package, problem of the week transparencies, estimation and mental math activities, activity cards for exploration centres and a professional handbook. The program focuses on engaging students in meaningful activities to build a community of learners, connecting mathematical experiences with other subjects and to the real world, encouraging communication through questioning and reflection about mathematical ideas, and involving families. Assessment is linked to instruction. Eleven units are built around key mathematical ideas, with a chart outlining essential understandings, benchmarks and pacing that summarizes the concepts taught at each grade level. Technology suggestions are included.

System Requirements:
Macintosh: System 6.0.5 system or later, 4 Mb RAM, mouse, either ClarisWorks v2.0 or higher, or Microsoft Works v3.0 or later.
Windows 3.1: 386/33 MHz, 4 Mb RAM, mouse, either ClarisWorks v1.0 or later, or Microsoft Works v3.0 or later.
Windows 95: 485/50 MHz, 8 Mb RAM, mouse, either ClarisWorks v1.0 or later, or Microsoft Works v3.0 or later.

Cautions:

The outcomes related to geometrical designs, symmetry and motion geometry are not addressed.
Use of ordered pairs, such as (5,7), is confined to the graphing of numerical patterns.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
						✓						

Year Recommended in Grade Collection: 1999

Supplier: *Pearson Education Canada*
26 Prince Andrew Place
Don Mills, ON M3C 2T8

Tel: (416) 447-5101 **Fax:** 1-800-563-9196

Toll Free: 1-800-387-8028/7851

Web Address: www.personed.ca

Price: Student Book: $21.95
Teacher's Guide & Journal: $99.95

ISBN/Order No: Student Book: 0-201-55275-2
Teacher's Guide & Journal: 0-201-55276-0

Copyright: 1996

The Show & Tell GeoBoard Collection

Author(s): D'Angela, J.; Lessard, P.

General Description:

Resource binder focusses on hands-on activities using geoboards and geopaper to develop understanding of patterning, counting, two-dimensional figures, slides and flips. Provides project work as well as group and individual assignments. Includes teacher notes, blackline masters and evaluation techniques.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
	✓	✓	✓	✓								

Year Recommended in Grade Collection: 1999

Supplier: *Exclusive Educational Products (B.C.)*
3436 West 35th Avenue

Vancouver, BC V6N 2N2

Tel: (604) 266-2261 **Fax:** (604) 266-2287

Toll Free: 1-800-563-1166

Price: $31.46

ISBN/Order No: Not available

Copyright: 1992

Solve It Series (Grade 5)

General Description:

Set of eight 15-minute videos illustrate the application of mathematics to a variety of real-life situations. Examples are American and Imperial measure is sometimes used. Accompanying teacher's guide provides pre- and post-viewing questions and activities. Some of the clips are dated, but the main instructional segments remain relevant and accurate.

Cautions:

In the video *Measurement: Precision and Estimation* a girl is shown raising her fist towards her companion.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
					✓							

Year Recommended in Grade Collection: 1999

Supplier: *B.C. Learning Connection Inc.*
#4 - 8755 Ash Street
Vancouver, BC V6P 6T3

Tel: (604) 324-7752 **Fax:** (604) 324-1844

Toll Free: 1-800-884-2366

Price: $26.00 each

ISBN/Order No: MA0023-MA0030

Copyright: 1987

Statistics: Sampling

General Description:

Within the context of an American junior high school election campaign for president, this fifteen-minute video presents the concept of sampling as a tool for research by examining how a sample group should relate to the larger population being studied. Students learn to question whether a particular sample is representative of the larger population. The director of the Preview House in Hollywood explains how sampling is used to determine the preferences of the U.S. population. Accompanying teacher's guide provides pre- and post-viewing questions and activities. Although somewhat dated, the main instructional segments remain relevant and accurate. Refers to Imperial measure.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
						✓						

Year Recommended in Grade Collection: 1999

Supplier: *B.C. Learning Connection Inc.*
#4 - 8755 Ash Street
Vancouver, BC V6P 6T3

Tel: (604) 324-7752 **Fax:** (604) 324-1844

Toll Free: 1-800-884-2366

Price: $26.00

ISBN/Order No: MA0022

Copyright: 1987

Statistics Workshop

General Description:

Macintosh software provides a set of computer tools for understanding and exploring fundamental concepts of data analysis. Students can explore the underlying meaning of abstract statistical concepts and processes. Provides an easy-to-use system for entering, manipulating and displaying data. It indicates the mean, median, and mode of the data, as well as quartiles, range and line of best fit, and a variety of statistical measures for each graph. It also contains a spreadsheet of flexible size for entering data and sample data sets that can be used for the analysis of data points. Includes a binder with support materials.

System Requirements: Macintosh Plus or later (Classic or later recommended) 1 Mb RAM.

Cautions:

The resource goes beyond the outcomes of the Protocol framework in some areas, e.g., best-fit lines and scatter plots at the Grade 9 level.
Although the software runs on a Mac Plus, screen displays are then inadequate.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Gage Educational Publishing Co. (Scarborough)*
164 Commander Boulevard
Scarborough, ON M1S 3C7

Tel: (416) 293-8464 ext. **Fax:** (416) 293-9009

Toll Free: 1-800-667-1115

Web Address: www.gagelearning.com

Price: $129.95

ISBN/Order No: Not available

Copyright: 1991

Step Up

Author(s): Morrison, H.; Morrison, B.

General Description:

Resource comprises a set of activities to develop skills and concepts in addition, subtraction, multiplication, division, ordering, comparing and order of operations with integers. Components are a teacher's resource binder with lessons, and an integer manipulative kit with positive and negative integer tiles, laminated circle mats, balloon symbols on clear mylar and an overhead set with acetates and transparent tiles.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Exclusive Educational Products (B.C.)*
3436 West 35th Avenue

Vancouver, BC V6N 2N2

Tel: (604) 266-2261 **Fax:** (604) 266-2287

Toll Free: 1-800-563-1166

Price: Text: $80.96
Manipulative Kit: $98.95

ISBN/Order No: Not available

Copyright: 1995

TesselMania

General Description:

Interactive software for Macintosh or Windows complements and extends the traditional process of cutting and pasting to create tessellations. Students can create complex tessellations electronically by modifying outlines and adding colourful interior details using the tool box. Animated sequences show how tessellations are created. Tessellations can be saved and printed. The teacher resource binder provides a sequence of suggested lesson plans for developing the connections between mathematics and art by using the transformational geometry concepts of translating, tessellating, rotating and reflecting.

System Requirements:
Macintosh: Macintosh LC or later 68020 or higher CPU) capable of reading high-density disks (or with SuperDrive), colour display recommended, System 6.0.7 or later, 2 Mb of RAM, hard drive, 32 bit Quick Draw, printer (optional).
Windows 3.1: 386/33 MHz (486 recommended), 4 Mb RAM, hard drive with 5 Mb of free disc space, printer (optional).
Windows 95: 486/50 MHz, 8 Mb RAM, hard drive with 20 Mb of free disc space, printer (optional).

Audience: General
Gifted - provides opportunities for extension

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
					✓	✓						

Year Recommended in Grade Collection: 1999

Supplier: *Core Curriculum Technologies*
101 - 3738 North Fraser Way
Burnaby, BC V5J 5K8

Tel: (604) 419-1234 **Fax:** (604) 430-8685

Toll Free: not in service

Price: Macintosh: $49.95
Windows: $49.95

ISBN/Order No: Macintosh: 0-792-90776-0
Windows: 0-792-90896-1

Copyright: 1995

Tick Tock: All About the Clock

General Description:

This 16-minute video discusses how to tell time on various types of clocks. Concepts covered include the functions of the hour, minute and second hands; how to tell time on a digital clock; how the earth and sun influence time and how time was told before the invention of clocks. This resource also explains what hours, minutes and seconds mean.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
✓	✓	✓	✓									

Year Recommended in Grade Collection: 1999

Supplier: *B.C. Learning Connection Inc.*
#4 - 8755 Ash Street
Vancouver, BC V6P 6T3

Tel: (604) 324-7752 **Fax:** (604) 324-1844

Toll Free: 1-800-884-2366

Price: $26.00

ISBN/Order No: MA0020

Copyright: 1992

Triple 'A' Mathematics Program: Data Management & Probability

General Description:

Binder of activities, projects and assessment items for data analysis and probability includes extensive teacher support in terms of suggested teaching strategies, sequencing and scoring rubrics. Activities include both routine calculation and open-ended projects. Some activities involve critical thinking. Provides random number tables, but other manipulatives must be provided by the teacher. There is no discussion of the best-fit line at the Grade 9 level.

Audience: General

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Exclusive Educational Products*
243 Saunders Road
Barrie, ON L4N 9A3

Tel: (705) 725-1166 **Fax:** (705) 725-1167

Toll Free: 1-800-563-1166

Web Address: www.exclusiveeducational.ca

Price: $33.26

ISBN/Order No: Not available

Copyright: 1995

Understanding Math Series

General Description:

CD-ROM series for Macintosh or Windows assists students in developing an understanding of mathematics concepts based on a solid foundation of concrete activities. Topics include fractions, integers, exponents, algebra, equations, coordinate geometry and graphing and percent. For each topic the program contains concept sections with explanation, example sections, practice sections and cumulative checks. The user is in control through pull-down menus and proceed and go-back buttons. Each program includes a teacher manual.

System Requirements:
Macintosh: 68020 or faster processor, including Power Macintosh, Macintosh 7.5.1 or later, 40 Mb hard drive space or CD-ROM drive.
Windows: Windows 3.1, Windows 95, Windows NT3.51 or 4.0; 486DX2-66 (Pentium recommended); 640x480 with 256 colour display (or higher); 40 Mb hard drive space or CD-ROM drive.

Cautions:

Some problems may appear while running the software with only the minimum system requirements. Increasing memory partition to 6 Mb avoids graphics problems.

Audience: General
LD - can be used for remediation

Category: Student, Teacher Resource

Grade Level:

K	1	2	3	4	5	6	7	8	9	10	11	12
							✓					

Year Recommended in Grade Collection: 1999

Supplier: *Gage Educational Publishing Co. (Scarborough)*
164 Commander Boulevard
Scarborough, ON M1S 3C7

Tel: (416) 293-8464 ext. **Fax:** (416) 293-9009

Toll Free: 1-800-667-1115

Web Address: www.gagelearning.com

Price: $79.95 each

ISBN/Order No: Various

Copyright: 1996

Appendix C

Cross-Curricular Outlines

The three principles of learning described in the introduction of this IRP support the foundation of the K to 12 Education Plan. They have guided all aspects of the development of this document, including the curriculum outcomes, instructional strategies, assessment strategies, and learning resource evaluations. In addition to the three principles, it is recognized that British Columbia's schools include young people of varied backgrounds, interests, abilities, and needs. In order to meet these needs and ensure equity and access for all learners, the development of each component of this document has also been guided by a series of cross-curricular outlines. It is expected that these principles and cross-curricular outlines will guide the users of this document as they engage in school and classroom organization and instructional planning and practice.

The following cross-curricular outlines have been used to focus the development and evaluation of the components of the IRP:

- Applied Focus in Curriculum
- Career Development
- Environment and Sustainability
- English as a Second Language (ESL)
- First Nations Studies
- Gender Equity
- Information Technology
- Media Education
- Multiculturalism and Anti-Racism Education
- Science-Technology-Society
- Special Needs

APPLIED FOCUS IN CURRICULUM

An applied focus in all subjects and courses promotes the use of practical applications to demonstrate theoretical knowledge. Using real world and workplace problems and situations as a context for the application of theory makes school more relevant to students' needs and goals. An applied focus strengthens the link between what students need to know to function effectively in the workplace or in post-secondary education and what they learn in Kindergarten through Grade 12.

Implementation of an applied approach involves working with a wide range of partners including universities, colleges, institutes, employers, community groups, parents, and government.

The applied focus in curriculum is consistent with the following statements in *The Kindergarten to Grade 12 Education Plan:*

> "All levels of the program are developed around a common core of learning to ensure that students learn to read, write, and do mathematics, solve problems, and use computer-based technology."
>
> "Employers expect graduates to be good learners, to think critically and solve problems, to communicate clearly, to be self-directed, and to work well with others. The new workplace also requires people to be knowledgeable about technology and able to search out and apply information from many sources."

Some examples of an applied focus in different subjects are:

Language Arts English—increasing emphasis on language used in everyday situations and in the workplace, such as job interviews, memos, letters, word processing, technical communication (including the ability to interpret technical reports, manuals, tables, charts, and graphics)

Mathematics—more emphasis on skills needed in the workplace, including probability and statistics, logic, measurement theory, and problem solving

Science—more practical applications and hands-on experience of science such as: reducing energy waste in school or at home; caring for a plant or animal in the classroom; using computers to produce tables and graphs, and for use of spreadsheets

Business Education—more emphasis on real-world applications such as preparing résumés and personal portfolios, participating in groups to solve business communication problems, using computer software to keep records, and using technology to create and print marketing material

Visual Arts—real-world applications such as working co-operatively to make images of social significance for their classroom, school or community; viewing and analyzing objects and images from their community; and experimenting with a variety of materials to make images

This summary is from a review of the literature, *The Kindergarten to Grade 12 Education Plan* (September 1994), and curriculum documents from British Columbia and other jurisdictions.

CAREER DEVELOPMENT

What is Career Development?

Career development is an ongoing process through which learners integrate their personal, family, school, work, and community experiences to facilitate career and lifestyle choices. The main emphases of career development are career awareness, career exploration, career preparation, career planning, and career work experience.

In the process of career development students develop:

- an open attitude toward a variety of occupations and types of work
- an understanding of the relationship between work and leisure, work and the family, and work and one's interests and abilities
- an understanding of the role of technology in the workplace and in daily life
- an understanding of the relationship between work and learning
- an understanding of the changes taking place in the economy, society, and job market
- an ability to construct learning plans and reflect on the importance of lifelong learning
- an ability to prepare for multiple roles throughout life

In the Primary Years

Career awareness promotes an open attitude towards a variety of career roles and types of work. Topics include:

- the role of work and leisure
- the relationships among work, the family, one's personal interests, and one's abilities

A variety of careers can be highlighted through the use of in-class learning activities

focusing on the students themselves and on a range of role models, including non-traditional role models.

In Grades 4 to 8

The emphasis on self-awareness and career awareness is continued. Topics include:

- interests, aptitudes, and possible future goals
- technology in the workplace and in our daily lives
- social, family, and economic changes
- future education options
- career clusters (careers that are related to one another)
- lifestyles
- external influences on decision making

Games, role playing, drama, and appropriate community volunteer experience can be used to help students actively explore the world of work. Field experiences in which students observe and interview workers in their occupational environments may also be appropriate. These learning activities will facilitate the development of interpersonal communications and group problem-solving skills needed in the workplace and in other life situations.

In Grades 9 and 10

The emphasis is on providing students with opportunities to prepare for and make appropriate and realistic decisions. In developing their Student Learning Plans, they will relate self-awareness to their goals and aspirations. They will also learn many basic skills and attitudes that are required for an effective transition into adulthood. This will assist in preparing them to be responsible and self-directed throughout their lives.

Topics include:

- entrepreneurial education
- employability skills (e.g., how to find and keep a job)
- the importance of lifelong education and career planning
- involvement in the community
- the many different roles that an individual can play throughout life
- the dynamics of the working world (e.g., unions, unemployment, supply/demand, Pacific Rim, free trade)

The examination of personal interests and skills through a variety of career exploration opportunities is emphasized at this level (e.g., job shadowing). Group discussion and individual consultation can be used to help students examine and confirm their personal values and beliefs.

In Grades 11 and 12

The emphasis of career development in grades 11 and 12 is focused more specifically on issues related to the world of work. These include:

- dynamics of the changing work force and changing influences on the job market (e.g., developing technology and economic trends)
- job keeping and advancement skills (interpersonal skills needed in the workplace, employment standards)
- occupational health issues and accessing health support services
- funding for further education
- alternate learning strategies and environments for different life stages
- mandatory work experience (minimum 30 hours)

Work Experience

Work experience provides students with opportunities to participate in a variety of workplace experiences that help prepare them for the transition to a work environment. Work experience will also provide students with opportunities to:

- connect what they learn in school with the skills and knowledge needed in the workplace and society in general
- experience both theoretical and applied learning, which is part of a broad liberal education
- explore career directions identified in their Student Learning Plans

Descriptions of career development are drawn from the ministry's *Career Developer's Handbook, Guidelines for the Kindergarten to Grade 12 Education Plan, Implementation Resource, Part 1,* and the draft of the *Prescribed Provincial Curriculum for Personal Planning, Kindergarten to Grade 12*, January 1995.

ENVIRONMENT AND SUSTAINABILITY

What is Environmental Education?

Environmental education is defined as a way of understanding human relationships with the environment. It involves:

- students learning about their connections to the natural environment through all subjects
- students having direct experiences in the environment, both natural and human-built
- students making decisions and acting for the environment

The term *sustainability* helps to describe societies that "promote diversity and do not compromise the natural world for any species in the future."

Why Integrate Environment and Sustainability Themes into the Curriculum?

These themes facilitate individuals having a responsible attitude toward caring for the earth that integrates environment studies and sustainability themes. Studies that integrate environment and sustainability themes provide students with opportunities to identify their beliefs and opinions, reflect on a range of views, and ultimately make informed and responsible choices.

The guiding principles that should be interwoven in subjects from K to 12 are:

- direct experience is the basis of human learning
- analysis of interactions help humans make sense of their environment
- responsible action is both integral to and a consequence of environmental education

Some organizing principles are:

- human survival depends on complex natural and human-built systems
- human decisions and actions have environmental consequences
- students should be provided opportunities to develop an aesthetic appreciation of the environment

Sample theme study units could be: Consumerism, School Operating Systems, Pollution, and Endangered Species.

This summary is derived from *Environmental Education/ Sustainable Societies - A Conceptual Framework*, Curriculum Branch, 1994.

ENGLISH AS A SECOND LANGUAGE (ESL)

What is English as a Second Language (ESL)?

ESL assistance is provided to students whose "use of English is sufficiently different from standard English to prevent reaching his or her potential." Many students learning English speak it quite fluently and seem to be proficient. School, however, demands a more sophisticated variety of English, both read and written. Thus, even fluent speakers could require ESL to provide them with the appropriate language experience that is unavailable outside the classroom. ESL is a transitional service rather than a subject. Students are in the process of learning the language of instruction and in many cases, the content matter of subjects appropriate to their grade level. Thus ESL does not have a specific curriculum. The provincial curriculum forms the basis of a great deal of the instruction and is used to teach English as well as individual subject areas. It is the methodology, the focus, and the level of engagement with the curriculum that differentiates ESL services from other school activities.

Who Are the Students in ESL?

Nearly 10 per cent of the British Columbia school population is designated as ESL. These students come from a great diversity of backgrounds. Most are recent immigrants to British Columbia. Some are Canadian-born but have not had the opportunity to learn English before entering the primary grades. The majority of ESL students have a well-developed language system and have had similar schooling to that of British Columbia-born students. A small number, because of previous experiences, are in need of basic support such as literacy training, academic upgrading, and trauma counselling.

Teachers may have ESL students at any level in their classes. Many ESL students are placed in subject area classes primarily for the purpose of contact with English-speaking peers and experience with the subject and language. Other ESL students are wholly integrated into subject areas. A successful integration takes place when the student has reached a level of English proficiency and background knowledge in a subject to be successful with a minimum of extra support.

How Can ESL Students Learn Best?

The guiding principle for ESL support is the provision of a learning environment where the language and the concepts can be understood by students.

Good practices to enhance the learning of students include:

- using real objects and simple language at the beginning level
- taking into consideration other cultural backgrounds and learning styles at any level
- providing adapted (language-reduced) learning materials
- respecting a student's "silent period" when expression does not reflect the level of comprehension
- allowing students to practise and internalize information before giving detailed answers
- differentiating between form and content in student writing
- keeping in mind the level of demand placed on students

This summary is drawn from *Supporting Learners of English; Information for School and District Administrators*, RB0032, 1993, and *ESL Policy Discussion Paper (Draft)*, Social Equity Branch, December 1994.

FIRST NATIONS STUDIES

What are First Nations Studies?

First Nations studies focus on the richness and diversity of First Nations cultures and languages. These cultures and languages are examined within their own unique contexts, and within historical, contemporary, and future realities. First Nations studies are based on a holistic perspective that integrates the past, present, and future. First Nations peoples are the original inhabitants of North America and lived in sophisticated, organized, and self-sufficient societies. The First Nations constitute a cultural mosaic as rich and diverse as Western Europe. There are many groups of people with differences in culture (e.g., Nisga'a, KwaKwaka'Wakw, Nlaka'pamux, Secwepemc, Skomish, Tsimshian). Each is unique and has a reason to be featured in the school system. The First Nations of British Columbia constitute an important part of the historical and contemporary fabric of the province.

Why Integrate First Nations Studies into the Curriculum?

- First Nations values and beliefs are durable and relevant today.
- There is a need to validate and substantiate First Nations identity.
- First Nations peoples have strong, dynamic, evolving cultures that have adapted to changing world events and trends.
- There is a need to understand similarities and differences among cultures to create tolerance, acceptance, and mutual respect.
- There is a need for informed, reasonable discussions and decisions regarding First Nations issues based on accurate, reliable information (for example, as modern treaties are negotiated by Canada, British Columbia, and First Nations).

In studying First Nations, it is expected that students will:

- demonstrate an understanding and appreciation for the values, customs, and traditions of First Nations peoples
- demonstrate an understanding and appreciation for unique First Nations communications systems
- demonstrate a recognition of the importance of the relationship between First Nations peoples and the natural world
- point out dimensions of First Nations art as a total cultural expression
- give examples of the diversity and functioning of the social, economic, and political systems of First Nations peoples in traditional and contemporary contexts
- describe the evolution of human rights and freedoms as they pertain to First Nations peoples

Some examples of the integration of First Nations material into subject curricula are:

Visual Arts—students may compare the artistic styles of two or more First Nations cultures

Language Arts English—students may analyze portrayals and images of First Nations peoples in various works of literature

Home Economics—students may identify forms of food, clothing, and shelter in past and contemporary First Nations cultures

Technology Education—students may describe the sophistication of traditional First Nations technologies (bentwood or kerfed boxes, weaving, fishing gear)

Physical Education—students may participate in and develop an appreciation for First Nations games and dances

This summary is derived from *First Nations Studies - Curriculum Assessment Framework (Primary through Graduation),* published by the Aboriginal Education Branch in 1992; and from the *B.C. First Nations Studies 12 Curriculum,* published by the Aboriginal Education Branch in 1994.

GENDER EQUITY

Gender equitable education involves the inclusion of the experiences, perceptions, and perspectives of girls and women, as well as boys and men, in all aspects of education. It will initially focus on girls in order to redress historical inequities. Generally, the inclusive strategies, which promote the participation of girls, also reach males who are excluded by more traditional teaching styles and curriculum content.

Principles of gender equity in education are:

- all students have the right to a learning environment that is gender equitable
- all education programs and career decisions should be based on a student's interest and ability, regardless of gender
- gender equity incorporates a consideration of social class, culture, ethnicity, religion, sexual orientation, and age
- gender equity requires sensitivity, determination, commitment, and vigilance over time
- the foundation of gender equity is co-operation and collaboration among students, educators, education organizations, families, and members of communities

Research suggests the following general strategies for gender equitable teaching:

- be committed to learning about and practising equitable teaching
- create a supportive environment for all students, regardless of factors such as gender, abilities, or cultural background
- highlight the social aspects and usefulness of activities, skills, and knowledge
- model non-biased behaviour—use inclusive, parallel, or gender sensitive language
- teach male and female students strategies to recognize and eliminate the inequities they observe
- move around the classroom, create mixed seating plans, and/or group the desks in a variety of ways—this will provide more opportunity to focus on quiet students
- ensure that all resources in the classroom are free of gender bias
- observe your questioning techniques—On whom do you call most often and why? Do you commonly ask leading or probing questions of both boys and girls?
- provide specific strategies, special opportunities, and resources to encourage students to excel in areas of study in which they are typically under-represented
- modify content, teaching style, and assessment practices to make non-traditional subjects more relevant and interesting for boys and girls
- be aware of accepted gender bias practices in physical activity—team sport, funding for athletes, and choices in physical education programs
- ensure consistent standards of achievement, courtesy, behaviour, and dress
- design lessons to explore many perspectives and to use different sources of information—refer to female and male "experts"
- allow more time for students to respond to questions—faster pace typically favours males, who are more likely to jump into classroom discussions
- share information and build a network of colleagues with a strong commitment to equity
- have colleagues observe your teaching and discuss any bias they may observe
- be consistent over time

This summary is from the preliminary *Report of the Gender Equity Advisory Committee,* received by the Ministry of Education in February 1994, and from a review of related material.

INFORMATION TECHNOLOGY

What is Information Technology?

Information technology is the use of tools and electronic devices that allow us to create, explore, transform, and express information.

Why Integrate Information Technology into the Curriculum?

As Canada moves from an agricultural and industrial economy to the information age, students must develop new knowledge, skills, and attitudes. The information technology curriculum has been developed to be integrated into all new curricula to ensure that students know how to use computers and gain the technological literacy demanded in the workplace.

Overall, students will acquire skills in analyzing and evaluating information, word processing, database analysis, information management, graphics, and multimedia applications. Students will also identify ethical and social issues arising from the use of information technology.

With information technology integrated into the curriculum, students will be expected to:

- demonstrate basic skills in handling information technology tools
- demonstrate an understanding of information technology structure and concepts
- relate information technology to personal and social issues
- define a problem and develop strategies for solving it
- apply search criteria to locate or send information
- transfer information from external sources
- evaluate information for authenticity and relevance
- arrange information in different patterns to create new meaning
- modify, revise, and transform information
- apply principles of design affecting the appearance of information
- deliver a message to an audience using information technology

The curriculum organizers are: Foundations, Explorations, Transformations, and Expressions.

Foundations—the basic physical skills, intellectual, and personal understandings required to use information technology, as well as self-directed learning skills and socially responsible attitudes

Explorations—defining a problem to establish a clear purpose for search strategies and retrieval skills

Transformations—filtering, organizing, and processing information

Expressions—designing, integrating, and presenting a message using text, audio and visual information, and message delivery

This information is derived from the draft *Information Technology Curriculum K to 12* currently under development.

MEDIA EDUCATION

What is Media Education?

Media education is a multidisciplinary and interdisciplinary approach to the study of media. Media education deals with key media concepts, and focuses on broad issues such as the history and role of media in different societies, and the social, political, economic, and cultural issues related to the media. Instead of addressing the concepts in depth, as one would in media studies, media education deals with most of the central media concepts as they relate to a variety of subjects.

Why Media Education in B.C. Schools?

Popular music, television, film, radio, magazines, computer games, information services, media, and media messages are pervasive in the lives of students today. Media education develops students' ability to think critically and independently about issues that affect them. Media education encourages students to identify and examine the values contained in media messages. It also cultivates the understanding that these messages are produced by others to inform, persuade, and entertain for a variety of purposes. Media education helps students understand the distortions that may result from the use of particular media practices and techniques. There are learning opportunities for media education in all curriculum areas. Media education is not taught as a separate curriculum.

The key concepts for media education are:

- analysis of media products (purpose, values, representation, codes, conventions, characteristics, and production)
- audience interpretation and influence (interpretation, influence of media on audience, influence of audience on media)
- media and society (control, scope)

Examples of integrating key concepts are:

Language Arts English—students critique advertising and examine points of view

Visual Arts—students analyze the appeal of an image by age, gender, status, etc., of the designated audience

Drama—students critically view professional and amateur theatre productions, dramatic films, and television programs to identify purpose

Social Studies—students compare the depiction of First Nations in the media over time

This summary is derived from *A Cross-Curriculur Planning Guide for Media Education* prepared by the Canadian Association for Media Education for the Curriculum Branch in 1994.

MULTICULTURALISM AND ANTI-RACISM EDUCATION

What is Multiculturalism Education?

Multiculturalism education stresses the promotion of understanding, respect, and acceptance of cultural diversity within our society.

Multiculturalism education involves:

- recognizing that everyone belongs to a cultural group
- accepting and appreciating cultural diversity as a positive feature of our society
- affirming that all ethnocultural groups have equality of status within our society
- understanding multiculturalism education is for all students
- recognizing that most cultures have much in common and similarities across cultures are much greater than differences, and recognizing cultural pluralism as a positive aspect in our society
- affirming and enhancing self-esteem through pride in heritage, and providing opportunities for individuals to appreciate the cultural heritages of others
- promoting cross-cultural understanding, citizenship, and racial harmony
- students examine the influence of the media on body concepts and healthy lifestyle choices

What is Anti-Racism Education?

Anti-racism education promotes the elimination of racism through identifying and changing institutional policies and practices, as well as identifying individual attitudes and behaviours that contribute to racism.

Anti-racism education involves:

- proposing the need to reflect about one's own attitudes on race and anti-racism
- understanding what causes racism in order to achieve equality
- identifying and addressing racism at both the personal and institutional level
- acknowledging the need to take individual responsibility for eliminating racism
- working towards removing systemic barriers that marginalize groups of people
- providing opportunities for individuals to take action in eliminating all forms of racism, including stereotypes, prejudice, and discrimination

Why Multiculturalism and Anti-Racism Education in B.C. Schools?

Multiculturalism and anti-racism education will contribute to quality education through learning experiences that promote strength through diversity, and social, economic, political, and cultural equity. Multiculturalism and anti-racism education will also provide students with learning experiences that are intended to enhance their social, emotional, aesthetic, artistic, physical, and intellectual development. It will also provide learners with the tools of social literacy and skills for effective cross-cultural interaction with diverse cultures. It also recognizes the importance of collaboration among students, parents, educators, and communities working towards social justice in the education system.

The key concepts for multiculturalism and anti-racism education are:

- enhance understanding of and respect for cultural diversity
- increase creative intercultural communication in a pluralistic society
- provide equal access to quality programs for educational achievement for all learners regardless of culture, national origin, religion, or social class
- develop self-worth, respect for oneself and others, and social responsibility
- combat and eliminate stereotyping, prejudice, discrimination, and other forms of racism
- include the experiences of all students in school curricula

Examples of integration with subjects could be:

Fine Arts—students identify ways in which the Fine Arts portray cultural experiences

Humanities—students identify similarities and differences within cultural groups' lifestyles, histories, values, and beliefs

Mathematics/Science—students recognize that individuals and cultural groups have used both diverse and common methods to compute, to record numerical facts, and to measure

Physical Education—students can develop an appreciation for games and dances from diverse cultural groups

This summary is derived from *Multicultural and Anti-Racism Education - Planning Guide (Draft),* developed in the Social Equity Branch in 1994.

SCIENCE-TECHNOLOGY-SOCIETY

What is Science-Technology-Society?

Science-Technology-Society (STS) addresses our understanding of inventions and discoveries and how science and technology affect the well-being of individuals and our global society.

The study of STS includes:

- the contributions of technology to scientific knowledge and vice versa
- the notion that science and technology are expressions of history, culture, and a range of personal factors
- the processes of science and technology such as experimentation, innovation, and invention
- the development of a conscious awareness of ethics, choices, and participation in science and technology

Why Integrate STS into the Curriculum?

The aim of STS is to enable learners to investigate, analyze, understand, and experience the dynamic interconnectedness among science, technology, and human and natural systems.

The study of STS in a variety of subjects gives students opportunities to:

- discover knowledge and develop skills to foster critical and responsive attitudes towards innovation
- apply tools, processes, and strategies for actively challenging emerging issues
- identify and consider the evolution of scientific discovery, technological change, and human understanding over time, in the context of many societal and individual factors
- develop a conscious awareness of personal values, decisions, and responsible actions about science and technology
- explore scientific processes and technological solutions
- contribute to responsible and creative solutions using science and technology

The organizing principles of STS are: Human and Natural Systems, Inventions and Discoveries, Tools and Processes, Society and Change.

Each organizer may be developed through a variety of contexts, such as the economy, the environment, ethics, social structures, culture, politics, and education. Each context provides a unique perspective for exploring the critical relationships that exist, and the challenges we face as individuals and as a global society.

Examples of linkages with subjects are:

Visual Arts—the demands generated by visual artists have led to the development of new technologies and processes (e.g., new permanent pigments, fritted glazes, drawing instruments)

Language Arts English—many technologies have recently influenced listening, speaking, and writing (e.g., CDs, voice mail, computer-generated speech)

Physical Education—how technology has affected our understanding of the relationship between activity and well-being

This summary is derived from *Science-Technology-Society—A Conceptual Framework*, Curriculum Branch, 1994.

SPECIAL NEEDS

Students with special needs are those with intellectual, physical, sensory, learning, behavioural, or emotional disabilities; students who are gifted or talented; and students who require special services and adaptations in order to reach their individual potential.

All students can benefit from an inclusive learning environment that is enriched by the diversity of the people within it. Opportunities for success are enhanced when provincial learning outcomes and resources are developed with regard for a wide range of student needs, learning styles, and modes of expression.

Educators can assist in creating more inclusive learning environments by attending to the following:

- activities that focus on development and mastery of foundational skills (basic literacy)
- a range of co-operative learning activities and experiences in the school and community; and application of practical, hands-on skills in a variety of settings
- references to specialized learning resources, equipment, and technology
- examples of ways to accommodate for special needs (e.g., incorporating adaptations/extensions to content, process, product, pacing, and learning environment; suggesting alternate methodologies or strategies; making references to special services)
- a variety of ways for students to demonstrate learning, not just through paper-and-pencil tasks (e.g., dramatizing events to demonstrate understanding of a poem, recording observations in science by drawing, composing/performing a music piece)
- promotion of the capabilities and contributions of children and adults with special needs
- participating in physical activity

All students can work toward achievement of the provincial learning outcomes. Many students with special needs learn what all students are expected to learn. In some cases, the student's needs and abilities require that education programs be adapted or modified. A student's program may include regular instruction in some subjects, some subjects that are modified, and some subjects that are adapted. Adaptations and modifications are specified in the student's Individual Education Plan (IEP).

An Adapted Program addresses the learning outcomes of the prescribed curriculum, but provides adaptations so the student can participate in the program. These adaptations can include alternate formats for resources (e.g., Braille, books-on-tape), instructional strategies (e.g., use of interpreters, visual cues, and learning aids), and assessment procedures (e.g., oral exams, additional time). Adaptations may also be made in areas such as skill sequence, pacing, methodology, materials, technology, equipment, services, and setting. Students on adapted programs are assessed using the curriculum standards and can receive full credit.

A Modified Program has learning outcomes that are substantially different from the prescribed curriculum, and specifically selected to meet the student's special needs. For example, a Grade 5 student in language arts could be working on recognizing common signs and using the telephone. In this case, the learning outcomes are substantially different from those that most other students are working on. A student on a modified program is assessed in relation to the goals and objectives established in the student's IEP.

Ministry Publications to Support Teachers of Students with Special Needs

The following publications are currently available from the Learning Resources Branch, or are under development and will be made available soon:

The Universal Playground: A Planning Guide (Ministry of Education, 1991, FCG 129)

Hard of Hearing and Deaf Students—A Resource Guide to Support Classroom Teachers (Ministry of Education, 1994, RB0033)

Special Education Services—A Manual of Policies, Procedures and Guidelines (Ministry of Education, Response Draft-December 1994)

I.E.P. Planning Resource (Ministry of Education, 1995)

Students with Visual Impairments—A Resource Guide to Support Classroom Teachers (Ministry of Education, 1995)

Gifted Students—A Resource Guide to Support Classroom Teachers (Ministry of Education, 1995)

Foundation Studies Supplement: Essential and Supportive Skills for Students with Intellectual Disabilities — A Resource Guide to Support Classroom Teachers (Ministry of Education, 1995)

Teaching for Student Differences—A Resource Guide to Support Classroom Teachers (Ministry of Education, 1995)

Resource Handbook for Adapted Curriculum Software (Ministry of Education, 1995)

Awareness Series (Ministry of Education, 1995)

This summary is derived from the *Handbook for Curriculum Developers* (February 1994), and *Special Education Services - A Manual of Policies, Procedures and Guidelines* (Response Draft, December 1994).

Appendix D

Assessment and Evaluation

EVALUATING STUDENT PERFORMANCE

The *Guidelines for Student Reporting* (XX0260), September 1994, established the guidelines and policy for the evaluation of students and the reporting of student progress. The purpose of this section of the IRP is to provide classroom examples of criterion-referenced evaluation to illustrate the ways that teachers can incorporate criteria in the teaching of mathematics.

Evaluating student performance is a process that involves making judgments and decisions based on interpretation of evidence for the purposes of goal setting and reporting. Teachers use their insight, knowledge about learning, and experience with students, as well as specific criteria they establish, to make judgments about student performance in relation to expected learning outcomes. Based on this information, they make decisions about effective instruction for a student or a group of students, redirect efforts, and establish future learning goals.

Evaluation is most effective when teachers communicate this information to students and parents on an ongoing basis. When evaluation is seen as an opportunity to promote learning rather than as a final judgment, it shows learners their strengths and suggests how they can develop further. Students can then use this information to redirect efforts, make plans to practise the learning, and establish personal learning goals. As well, teachers and parents are better able to assist in goal setting, provide support, and enhance students' learning.

Evaluation may take different forms depending on its purpose. Criterion-referenced evaluation compares each student's performance to established criteria rather than to the performance of other students. Criterion-referenced evaluation is most appropriate for evaluating student performance in classrooms. Norm–referenced evaluation compares one student's achievement to that of others and is based on a "normal distribution." It is appropriate for large-scale system analysis, to determine scholarship distribution at the Grade 12 level, and for diagnostic testing such as the WISC-R.

Criterion-referenced evaluation requires that teachers establish criteria based on the expected learning outcomes. The criteria are aspects of a product, process, or demonstration, stated in specific terms, that outline what is involved in meeting the learning expectations. The criteria are used to guide, monitor, and evaluate learning. Teachers are better able to tell whether or not, and to what degree, students are able to meet the criteria and the learning expectations.

Criterion-referenced evaluation involves the following steps:

1. Identify the expected learning outcomes (as stated in IRPs).
2. Identify the key learning objectives for students.
3. Establish and set criteria.
4. Involve students, when appropriate, in establishing criteria.
5. Plan learning activities that will help students gain the knowledge or skills outlined in the criteria.
6. Inform students about the criteria their work will be evaluated against prior to the learning activity.
7. Provide examples of the desired levels of performance.
8. Implement the learning activities.
9. Use assessment methods that suit the particular assignment and students.
10. Review assessment data and evaluate each student's level of performance or quality of work in relation to the criteria.
11. Report the results of the evaluation to students and parents.

From *Guidelines for Student Reporting*, Ministry of Education, 1994

The following samples illustrate the process a teacher might use in applying criterion-referenced evaluation in mathematics. The samples represent a broad use of criterion-referenced evaluation, including individual pieces of work, units of study, and work completed over the course of a term.

Each sample uses the following process:

Planning for Assessment

This section outlines:

- background information to explain the classroom context
- instructional tasks
- the opportunities that students were given to practise learning
- the feedback and support that was offered students by the teacher
- the ways in which the teacher prepared students for the assessment

Defining Criteria

This section illustrates the specific criteria, which are based on:

- the learning outcomes
- the assessment task
- the *Evaluating Mathematical Development Across Curriculum* reference set

The criteria are organized under Attitudes, Mathematical Thinking, and Communication.

Assessing and Evaluating Student Performance

This section includes:

- the assessment tasks or activities
- the support that the teacher offered students
- the tools and methods used to gather the assessment information
- the way the criteria were used to evaluate the student performance

Sample 1 Grades K to 1

Curriculum Organizer: Space and Shape (3-D Objects and 2-D Shapes)

LEARNING OUTCOMES

It is expected that students will:

- identify and describe specific two-dimensional shapes as circles, squares, triangles, or rectangles
- compare, sort, classify, and pattern two-dimensional shapes
- construct and rearrange a design using a set of two-dimensional shapes

In addition to these outcomes the teacher will assess students':

- attitudes towards mathematics
- mathematical reasoning skills
- problem-solving skills
- group skills
- communication of mathematical ideas and thinking

PLANNING FOR ASSESSMENT

The teacher organized many learning experiences to help students recognize and describe two-dimensional shapes and three-dimensional objects in their environment. Students sorted and classified geometric shapes (pattern blocks, tangrams, attribute blocks, geometric blocks) and used them to make patterns. The teacher regularly gave students feedback on their attitudes towards mathematics, their reasoning, and their problem-solving and communication skills. Students were encouraged to reflect on their learning and describe how they worked on problems, how they shared their ideas, and the specific things they learned about two-dimensional shapes.

DEFINING CRITERIA

The teacher explained the criteria for assessment and expectations for learning in ways students could understand.

Attitudes

To what extent does the student:

- approach problems systematically
- take risks (unafraid to be wrong or unsuccessful)

Mathematical Thinking

To what extent does the student:

- identify and describe specific characteristics of two-dimensional shapes—circles, squares, triangles, or rectangles
- compare, sort, classify, and pattern two-dimensional shapes according to attributes
- construct and rearrange at least two designs using a set of two-dimensional shapes

Communication

To what extent does the student:

- talk in ways that make sense about the shapes that were used to make the picture
- listen to his/her partner's description and display listening behaviours

ASSESSING AND EVALUATING STUDENT PERFORMANCE

The students worked in groups of four. The teacher gave each child the same number, but different combinations, of attribute blocks. The students used as many of the blocks as they could to create a picture in a given amount of time. The teacher offered support by prompting students with questions (e.g., What animal could you make with these blocks?) and challenged their thinking by asking questions. (e.g., Can you be more specific? In what other ways could you create that picture?) The students shared their pictures and explained them to their partners. They used a combination of pictures, words, and mathematical symbols to record the shapes they constructed.

The teacher observed students as they worked, recording assessment information and the significant learning that students demonstrated in relation to the criteria. The teacher observed students during whole-class learning activities and small-group tasks, and also examined students' products. The teacher collected ongoing written descriptions of student performance, which was used in the planning of further instructional experiences. The *Evaluating Mathematical Development Across Curriculum* reference set was used as an assessment tool. Students' partial understanding indicated when intervention might be necessary. The teacher provided ongoing feedback and helped students set learning goals. Student growth over time was revealed by the assessment data collected throughout the Space and Shape unit.

EXAMPLES OF TEACHER NOTES

Student A attempted to write the two-dimensional shape names on her list. She used number symbols to record how many of each shape were used. She could read the recorded number correctly, although she did not yet have one-to-one correspondence when counting.

Student B decomposed his picture and sorted his shapes into triangles, squares, and circles. He then made a more refined classification for each of the shape categories: big, thin, thick, and so on.

Student C invited her partner to tell about his picture before she told about hers. (This was noted as significant growth for that student.)

Student D placed the circles in one category and the triangles and squares in a second category. When asked to explain this classification, she labelled all the "non-circle" shapes as triangles, "because they have sides."

Sample 2 Grades 2 to 3

Curriculum Organizer: Patterns and Relations (Patterns)

LEARNING OUTCOMES

It is expected that students will:

- identify, create, and describe number and non-number patterns
- translate patterns from one mode to another, using manipulatives, diagrams, charts, calculators, spoken and written terms, and symbols
- explain the rule for a pattern and make predictions on patterns using models and objects

In addition to these outcomes the teacher will assess students':

- attitudes towards mathematics
- reasoning and problem-solving skills
- group skills
- communication skills

PLANNING FOR ASSESSMENT

The teacher provided students with a variety of learning experiences using manipulatives such as pattern blocks, coloured counters, and classroom objects to create patterns and extend them in a variety of ways. Students translated patterns from one mode to another using a variety of materials and described their patterns verbally. They predicted how the patterns would continue based on repetition of shape, spatial organization, or numerical patterns.

DEFINING CRITERIA

The criteria were developed and explained to students. During the class discussion, students were given specific examples of how they might demonstrate attitudes, mathematical thinking, and communication skills while working on various patterning tasks.

Attitudes

To what extent does the student:

- persevere at mathematical tasks

Mathematical Thinking

To what extent does the student:

- recognize, extend, and describe mathematical patterns orally and numerically
- explain the rule for a pattern
- predict patterns based on a rule

Communication

To what extent does the student:

- show a willingness to participate with others
- seek and share ideas

ASSESSING AND EVALUATING STUDENT PERFORMANCE

Students were shown a "growing pattern" using concrete objects such as Unifix cubes and were encouraged to describe the rules of the pattern.

```
          o o o
     oo   o o o   ?
o    oo   o o o
```

The teacher asked questions to prompt and challenge students' thinking. (e.g., What changes happen from one step to the next? What stays the same? How might you extend this pattern?) The teacher observed the ways each student described the pattern using spatial (e.g., The square is getting bigger), numerical (e.g., First there is 1, then 4, then 9 . . .), or less formal mathematical language (e.g., . . . a little house, an apartment building, a skyscraper . . .). The teacher extended the task by asking students to extend two more patterns.

Students, in groups of two or three, used manipulatives to copy and extend the patterns for three or four more steps. They recorded the number of objects in each step. Students explained the rule for each pattern and made predictions based on the numerical pattern they identified.

In order to assess attitudes, mathematical thinking, and communication skills, the teacher created a performance rubric based on the criteria to describe expected student performance. The *Evaluating Mathematical Development Across Curriculum* reference set was also used as an assessment tool. The teacher told students what she would be looking for in her observations. The students were encouraged to comment on things they noticed that provided evidence that they or other students were working towards meeting their goals. Student performance and progress over the course of the term was indicated on individual rubric sheets by highlighting the appropriate descriptors and shading them in. This information was shared with the children and used to set learning goals.

A Performance Rubric: Patterns and Relations (Patterns)

	Beginning	Understanding and Applying	Extending
Attitudes • self-motivated to pursue and continue with the challenge	• completes two "growing patterns" with concrete objects; with support, is able to describe concrete patterns verbally and numerically	• completes two or more "growing patterns" with minimal support	• independently completes two or more "growing patterns"; sets personal challenges that may include: - extending the same pattern in a different way - creating new "growing patterns"
Mathematical Thinking • recognize, extend, and describe mathematical patterns orally and numerically • explain the rule for a pattern • predict patterns based on a rule	• recognizes, creates, and extends basic patterns with concrete objects • describes patterns numerically and verbally with teacher support • unable to explain the rule, or explanation is not clear • makes general predictions such as "It gets bigger."	• recognizes, creates and extends two or more patterns; describes patterns • requires prompting to explain the rule • makes predictions based on numerical data or concrete representations	• student representation reveals a complexity in choice of materials, additional dimensions (2D -> 3D), and/or symbolic representation • explains the rule in a logical manner without assistance • makes accurate predictions based on numerical data
Communication • willing to participate with others in seeking and sharing ideas	• may work alone • beginning to accept partner or group suggestions	• accepts most of the partner's or group members' suggestions and ideas • beginning to share ideas with the small group and the class	• accepts and encourages group interactions • frequently contributes ideas, in a variety of settings • listens attentively to others

Sample 3 Grade 4

Curriculum Organizer: Number (Number Operations)

LEARNING OUTCOMES

It is expected that students will:

- demonstrate and describe the process of addition and subtraction of numbers up to 10 000 using manipulatives, diagrams, and symbols

In addition to these outcomes the teacher will assess students':

- attitudes towards mathematics
- reasoning and problem-solving skills
- communication skills

PLANNING FOR ASSESSMENT

The teacher provided opportunities for students to solve problems involving addition, subtraction, multiplication, and division during the first term of the school year. Students used a variety of materials (e.g., counters, base-ten blocks) and calculation approaches (e.g., mental math, paper and pencil, and calculators). The class kept a list of "invented algorithms" – alternative ways that individual students solved the problems. Students were required to choose from the four operations to solve a given problem and to select the most appropriate way to do the calculations depending on the degree of accuracy required.

DEFINING CRITERIA

Students were given specific examples of how the teacher might know if they were working towards meeting the criteria while working on the task.

Attitudes

To what extent does the student:

- creatively respond to problem situations in new ways and quickly become engaged in the task

Mathematical Thinking

To what extent does the student:

- demonstrate understanding of how to subtract large numbers up to 10 000
- know when to choose the operation of subtraction to solve a problem

Communication

To what extent does the student:

- explain how to subtract large numbers using an algorithm
- use mathematical words, pictures, and symbols to communicate her/his ideas

ASSESSING AND EVALUATING STUDENT PERFORMANCE

The teacher gave students the following instructions "You want to teach your younger cousin how to subtract using four-digit numbers. Write out what you will say. Use concrete materials, pictures, and symbols to make your explanation clear. Give examples of a few word problems that you could solve using subtraction. Solve one of them in a different way than the one you described to your cousin."

The teacher examined students' written products and used a scoring rubric to evaluate each student's response based on the degree to which the student met the criteria. The teacher followed up with conversations and interviews with students who had experienced difficulty explaining their thinking in written form. The teacher also used the *Evaluating Mathematical Development Across Curriculum* reference set to determine the level of performance demonstrated by students.

HOLISTIC SCALE

Outstanding (5)	The explanation response is correct, complete, and clear for the intended audience (the younger cousin). It includes words, pictures, and symbols to help explain the ideas. Several examples are included that illustrate some of the complexities of specific cases (e.g., requiring regrouping). More than two different approaches are described.
Very good (4)	The response is correct and the explanation is clear. It includes words, pictures, and symbols. Sample problems are included with some complexity involved. Two methods for solving subtraction problems are illustrated.
Good (3)	The response is correct. The explanation is reasonable. Sample problems are included that show beginning levels of complexity. One method for solving subtraction is illustrated.
Satisfactory (2)	The response is correct and indicates that the student understands the solution, but the explanation lacks clarity. The student is able to describe his/her thinking orally.
IP (1)	The response indicates a partial solution. The student's understanding of the solution is not complete. The explanation is present but indicates some confusion. Further individual instruction and intervention is required.

Sample 4 Grade 5

Curriculum Organizer: Statistics and Probability (Data Analysis)

LEARNING OUTCOMES

It is expected that students will:

- identify a question to generate appropriate data and predict results
- create classifications and ranges for grouping data
- display data by hand or by computer in a variety of ways including frequency diagrams, line plots, and broken-line graphs
- evaluate the graphic presentation of the data to ensure clear representation of the results

In addition to these outcomes, the teacher will assess students':

- attitudes towards mathematics
- reasoning and problem-solving skills
- communication skills
- group skills

PLANNING FOR ASSESSMENT

Students worked on a data analysis unit that covered all eight learning outcomes for data analysis. The teacher introduced and reviewed necessary mathematical language and vocabulary. Students, individually and in small groups, investigated several questions and practised a variety of methods to collect, record, and display data. Lessons and class discussions highlighted the use of different graphs. Examples of graphs (pictographs, tables, bar graphs, frequency diagrams, broken-line graphs, and line plots) from newspapers and magazines were used to review students' prior knowledge and to informally assess their current understanding of the concepts. The class interpreted the graphs, discussed which questions the graph might be trying to answer, and determined the effectiveness of the different formats in communicating different types of information.

DEFINING CRITERIA

The teacher and students discussed the criteria and generated specific examples of ways that they could demonstrate the attitudes, mathematical thinking, and communication skills while working on the data analysis task.

Attitudes

To what extent does the student:

- take risks and question mathematical data and conclusions
- show a willingness to persevere

Mathematical Thinking

To what extent does the student:

- include a workable plan for useful data collection (questions, strategies)
- organize and present information in a clear, effective manner, including ranges for grouping data
- explain his/her reasoning, problems encountered, and conclusions in a daily log

Communication

To what extent does the student:

- communicate ideas to the class orally and using visual displays
- use mathematical language (terms and notation)
- accept group decisions and share responsibility for how the group works

ASSESSING AND EVALUATING STUDENT PERFORMANCE

The teacher gave students the following instructions for the task: "Your group's task is to make a plan for investigating a question. (e.g., How many cats would you find within three blocks of the school? What is the best hockey team?) You will begin by making a plan that will include the question that you will try to answer, ways you intend to collect the data, and a prediction of the results. From the list that I have written on the chalkboard, choose at least two different formats that you could use to display this information. Once you have collected the data, prepare an oral report and a visual display for the class. Keep a daily log of your work."

The teacher used a holistic rating scale to evaluate each student's performance. Equal weighting was given to each category. Students used the same scale for self-assessment, completed a self-evaluation for entry in their learning log, and included evidence to justify the level on the scale that best described their performance.

A Outstanding	The student fully achieved the purpose of the task, including thoughtful, insightful interpretations and conjectures; raised interesting questions; communicated ideas and findings fully and clearly in the oral presentation and in the visual display; worked well independently and collaboratively as required; and went beyond minimum quantity and quality expectations.
B Very good	The student achieved the purpose of the task, including thoughtful interpretations and conjectures; raised interesting questions and communicated ideas effectively; understood the task as demonstrated by the visual display; and worked well independently and collaboratively as required.
C+ Good	The student accomplished the required tasks and communicated ideas; demonstrated a basic understanding of the task through his/her visual display; and worked persistently with some teacher support to overcome problems encountered.
C Satisfactory	The students completed the task. The oral report communicated major ideas with few details. The visual display had all major components, but minor errors were apparent. The student worked with the group when necessary.
C- Minimally satisfactory	The student completed the visual display and the oral report at a basic level, but required support from the teacher and peers to work co-operatively with the group.

Sample 5 Grade 6

Curriculum Organizer: Patterns and Relations (Patterns)
Shape and Space (Measurement)

LEARNING OUTCOMES

Patterns and Relations (Patterns)

It is expected that students will:

- construct a visual representation of a pattern to clarify relationships and to verify predictions
- summarize a relationship using everyday language in spoken or written form
- predict pattern relationships

Shape and Space (Measurement)

It is expected that students will:

- develop, verify, and use rules or expressions for the area of rectangles

PLANNING FOR ASSESSMENT

Students worked on solving a variety of problems such as:

- find all the squares on a checkerboard (Shape and Space)
- show how many three-digit numbers can be formed with the digits 5, 0, and 9; the digits can be used more than once (Number)
- the Handshake Problem (Patterns and Relations)

Students were introduced to problem-solving tools and strategies and used relationships to summarize, generalize, and extend patterns. They expressed the relationships in mathematical terms, using specific mathematical vocabulary, formulas, and equations.

DEFINING CRITERIA

Specific criteria for assessment were developed with students. The discussion included explicit examples of how students might demonstrate positive attitudes towards mathematics, mathematical thinking, and communication skills.

Attitudes

To what extent does the student:

- use alternative strategies and deal flexibly with challenges

Mathematical Thinking

To what extent does the student:

- create a visual representation of the pattern that clarifies relationships
- predict pattern relationships
- develop, verify, and use rules or expressions for the area of rectangles

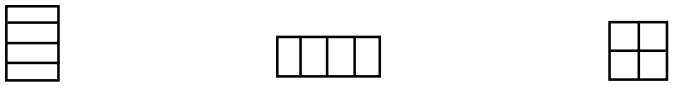
Communication

To what extent does the student:

- summarize the relationships using everyday language orally and in written form

ASSESSING AND EVALUATING STUDENT PERFORMANCE

The instructions for the assigned task were as follows: "Use square coloured tiles to build rectangles of different sizes. Build each rectangle in as many different ways as possible." For example, with four tiles it is possible to build:



"For each rectangle you build, collect the following data: length, width, and area. Choose a strategy or tool to organize your information in a way that will help you discover emerging patterns. From the numerical pattern, try to predict the area of any given rectangle. How can this be done without building the rectangle or counting all of the tiles? Describe the pattern you found to a classmate. Find at least one way to record the relationship mathematically (using numbers and symbols). Record the information."

The focus of this assessment task was to collect evidence that described students' ability to use strategies and tools (lists, tables, and equations), recognize patterns, and solve problems. The teacher used four ways to gather evidence of student learning (examples not included): coding students' performances using the problem-solving reference set, using an observation checklist, examining students' work samples to determine the degree to which individuals met the specific criteria, and using a self-assessment form completed by students.

Sample 6 Grade 7

Curriculum Organizer: Number (Number Concepts) (Number Operations)

LEARNING OUTCOMES

It is expected that students will:

- represent integers in a variety of concrete, pictorial, and symbolic ways
- compare and order integers
- demonstrate concretely and pictorially that the sum of opposite integers is zero
- add, subtract, multiply, and divide integers concretely, pictorially, and symbolically

In addition to these outcomes the teacher will assess students':

- attitudes towards mathematics
- reasoning and problem-solving skills
- communication skills

PLANNING FOR ASSESSMENT

Instructional strategies included individual and small-group work, as well as whole-class instruction and discussion. The teacher presented several different visual models for representing integers and invited students to bring examples of integers from the real world, for example, temperatures below and above zero, scores in games where penalty points are assessed, and altitudes above and below sea level. A record of "real-life" integer situations was posted on a chart, and students collected and added examples. Students demonstrated their understanding of the concepts by solving problems involving integers. They wrote their own integer problems, exchanged them with classmates, and solved them.

DEFINING CRITERIA

Students were given specific examples of how the teacher might know if they were working towards meeting the criteria while working on the task.

Attitudes

To what extent does the student:

- show a willingness to listen to and consider the ideas of others
- appreciate the application of mathematics in real-life situations

Mathematical Thinking

To what extent does the student:

- demonstrate that the sum of opposite integers is zero and explain why
- demonstrate and explain how to add, subtract, multiply, and divide integers concretely, pictorially, and symbolically
- solve problems involving integers using his/her method of choice

Communication

To what extent does the student:

- write problems involving integers
- explain why his/her word problems are realistic
- justify why the solutions are reasonable

ASSESSING AND EVALUATING STUDENT PERFORMANCE

A portfolio was kept for assessment and evaluation purposes. Students were permitted to work with a partner on most tasks, but each student was responsible for keeping a record of his/her work for each task. Teachers and students selected key samples of work to include in portfolios, which contained:

- practice exercises from the textbook related to the lessons taught
- four problem-solving tasks that demonstrated that the student had met the mathematical-thinking criteria
- one sample of an integer word problem created by the student and solved in two different ways, which included a rationale of why the problem was realistic and why the solution was reasonable
- a cover letter or summary describing the contents of the portfolio for the unit, the reason for choosing particular samples, and changes in his/her understanding

The teacher kept a record of students who had contributed to the class chart on integers. A holistic scale (not included) was developed and used to evaluate the work that was presented in student portfolios.

Sample 7 Grades 6 and 7

Curriculum Organizer: Number, Shape and Space, Statistics and Probability

LEARNING OUTCOMES

Number (Number Concepts) (Number Operations)

It is expected that students will:

- read and write numerals greater than a million (Grade 6)
- read and write numerals to any number of decimal places (Grade 7)
- use estimation strategies for quantities up to a million (Grade 6)
- use estimation strategies to predict or assess the reasonableness of their calculations (Grade 7)

Space and Shape (Measurement)

It is expected that students will:

- convert between commonly used SI units of measure (Grade 6)
- estimate, measure, and then calculate surface area of right rectangular prisms (Grade 6)

Statistics and Probability (Data Analysis)

It is expected that students will:

- analyse sets of data to make comparisons and test predictions (Grade 6)
- determine measures of central tendency for a set of data: mode, median, mean (Grade 7)

In addition to these outcomes, the teacher will assess students':

- attitudes towards mathematics
- reasoning and problem-solving skills
- communication skills

PLANNING FOR ASSESSMENT

The goal of this unit was for students to understand and be proficient in calculating decimal fractions and apply their understanding in problem-solving situations involving measurement concepts such as surface area. The Grade 6/7 class had studied number operations and place value. The teacher had also taught lessons and designed learning activities to develop students' conceptual and procedural understanding of area measurement. The unit of study included data analysis and integrated knowledge and applications from the Measurement and Number organizers. The concept of "measures of central tendency" (mean, median, mode) was introduced. The mathematics learning outcomes were integrated with social studies learning outcomes by including knowledge and understanding of world geography, scale and distance, and mapping skills with estimation and the calculation of surface area.

DEFINING CRITERIA

The teacher and students developed a rating form to assess and evaluate student performance on the assessment task. It outlined a number of specific criteria for assessment:

Attitudes

To what extent does the student:
- draw on and apply previously acquired information in new situations
- pursue and continue with challenges independently

Mathematical Thinking

To what extent does the student:
- analyse sets of data to make comparisons and test predictions (Grade 6)
- determine measures of central tendency for a set of data: mode, median, mean (Grade 7)
- convert between commonly used metric units of measure (Grade 6)

Communication

To what extent does the student:
- communicate mathematical ideas clearly in both oral and written form
- express the surface area in multiple ways (e.g., 3 400 000 km^2 /3.4 million km^2)
- make refined judgments and adjust his/her thinking based on additional information

ASSESSING AND EVALUATING STUDENT PERFORMANCE

Students, in groups, selected five countries (one from each continent) to study. Using scales on world maps, and a centimetre grid traced or photocopied on an overhead transparency, they estimated the area of a given country. They recorded their estimates and demonstrated one new way of calculating central tendency. For example, when students were familiar with finding the mean (average), the teacher showed them how to calculate mode or median. Students estimated the surface area and then consulted an atlas to check their estimates against the actual surface area. Students expressed the area in various ways (e.g., 3 400 000 km^2 or 3.4 million km^2). They continued the investigation for each of the four remaining countries and recorded their estimates.

A rating form for the total project was given to each individual student and group. Each student completed the rating form as a self-assessment. The teacher completed the same form, based on observations of student work in progress, conversations with small groups or individuals, and student work samples. A three-point scale was used, as in "3: outstanding or very good"; "2: good or satisfactory"; "1: minimally satisfactory or in progress." The teacher arranged interviews in which students and the teacher explained their evaluations and provided supporting evidence.

EVALUATING STUDENT PERFORMANCE

Student's Name _____ Date _____

Teacher's Name _____ Date _____

CRITERIA	STUDENT RATING	TEACHER RATING
Attitudes		
To what extent does the student:		
• draw on and apply previously acquired information in new situations	_____	_____
• pursue and continue with challenges independently	_____	_____
Mathematical Thinking		
To what extent does the student:		
• analyse sets of data to make comparisons and test predictions	_____	_____
• accurately determine measures of central tendency for a set of data: mode, median, mean	_____	_____
• accurately convert between commonly used metric units of measure	_____	_____
Communication		
To what extent does the student:		
• communicate mathematical ideas clearly in both oral and written form	_____	_____
• express the surface area in multiple ways (e.g., 3 4000 000 km^2/3.4 million km^2)	_____	_____
• make refined judgements and adjust his/her thinking based on additional information	_____	_____

Rating scale:

3: outstanding, very good 2: good, satisfactory 1: minimally satisfactory IP: in progress

Sample 8 Grades 5, 6, and 7

Curriculum Organizer: Space and Shape (Measurement) (Transformations)

LEARNING OUTCOMES

It is expected that the students will:

- recognize motion as a slide, flip, or turn (Grade 5)
- recognize tessellations created with regular and irregular shapes in the environment (Grade 5)
- create, analyse, and describe designs using slides (Grade 5), flips (Grade 6), and turns (Grade 7)
- use informal concepts of congruence to describe images of transformations (Grade 7)
- connect reflections with lines and planes of symmetry (Grade 7)

PLANNING FOR ASSESSMENT

In this unit, students performed, analysed, and developed their understanding of transformations. Grade 5 students were expected to describe motion in terms of a slide, flip, or turn, while Grade 6 and 7 students were expected to create and describe linear patterns and tessellation designs that incorporate translations (slides), reflections (flips), and rotations (turns). The concepts of symmetry and congruence were used to help describe the simple motions and combinations of more than one motion. Students studied the graphic works of M.C. Escher to discover the beauty of tessellating patterns in art. They examined tessellation patterns in the environment: wallpaper patterns, flooring patterns, paving stone designs, designs on clothing.

The teacher taught a series of lessons that helped students understand the mathematics underlying tessellations—why particular shapes tessellate a plane with no overlaps or gaps—and showed students how to create their own tessellation patterns. Students used pattern blocks to determine the angle measures of regular polygons. They hypothesized about which shapes would combine to cover the surface, and why they worked. From this exploration, students discovered that, in order to tessellate the plane, the sum of the angles around a given point must add up to 360°. The teacher introduced the terms to describe motion: *translation* (slide), *reflection* (flip), and *rotation* (turn). Students analysed designs to determine which transformations were used to create them. The teacher taught students how to modify regular polygons (squares, rectangles, and equilateral triangles) to create more lifelike shapes, which could then be traced to create a tessellation.

DEFINING CRITERIA

The teacher and students developed a rating form to assess and evaluate student performance on the assessment task.

Attitudes

To what extent does the student:

- persevere to find a solution
- challenge him/herself to try increasingly difficult problems

Mathematical Thinking

To what extent does the student:
- create, analyse, and describe designs using slides (Grade 5), flips (Grade 6), and turns (Grade 7)
- use concepts of congruence to describe images of transformations (Grade 7)
- modify the polygon's shape
- create an effective aesthetic design (e.g., use of colour, detail)

Communication

To what extent does the student:
- explain to others the modification of the polygon to create a design

ASSESSING AND EVALUATING STUDENT PERFORMANCE

Students were instructed to modify a regular polygon (square, rectangle, or equilateral triangle) to create a lifelike shape. They were also asked to tessellate the plane with their shapes to create a design, and finally to add colour and details to enhance the design.

This assessment task required students to integrate and apply their mathematical knowledge in order to create a new example of a modified polygon and to use it to create an Escher-like pattern. The evaluation was based on the specific criteria listed above. The degree of complexity and the overall effectiveness of the final design were taken into consideration. Students participated in creating a scale of difficulty that would be used for assessment purposes.

Level	Polygon	No. of sides modified	Transformation
1	rectangle	2	slide
2	rectangle	4	slide
3	rectangle	2	slide and flip
4	rectangle	4	slide and flip
5	triangle	2	rotation and slide
6	triangle	3	rotation and slide
7	rectangle	4	rotation and slide

Each student submitted a written paragraph that described his/her thinking and the process for creating the design (how the shape was created and which motion was used to tessellate the plane). They also completed self-assessments based on the criteria for attitudes towards mathematics and communication skills. The teacher used the *Evaluating Mathematical Development Across Curriculum* reference set as an assessment tool to further describe each student's learning and performance.

Evaluation for _____ **Date** _____

Portfolio	Evidence of work and thinking (4 points)	Student reflection (4 points)	Clarity/ neatness (2 points)	Total points
Practice exercises				
Task 1				
Task 2				
Task 3				
Task 4				
Word problem				
Cover letter				

Total points _____

MANAGING ASSESSMENT INFORMATION

Teachers keep track of changes in students' learning in a variety of ways. The techniques they use to monitor development enable them to make informed decisions about teaching and learning. The information in this section of the IRP is a collection of ideas to illustrate some of the ways that teachers keep track of changes and use this information to monitor student development in mathematics.

Evidence of growth in mathematics can be collected in three ways:

- by observing what students do
- by listening to what they say
- by reviewing their products

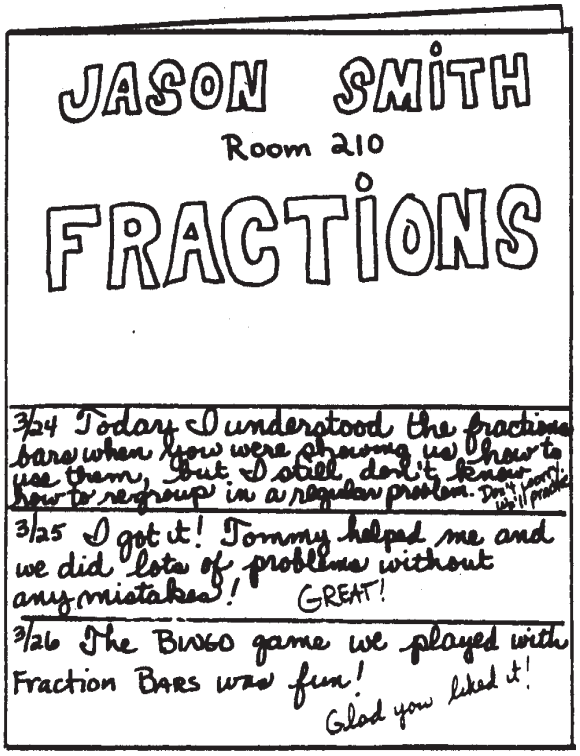
Valid judgments about individual students require repeated opportunities to observe, listen to, and review their work.

Student Journals

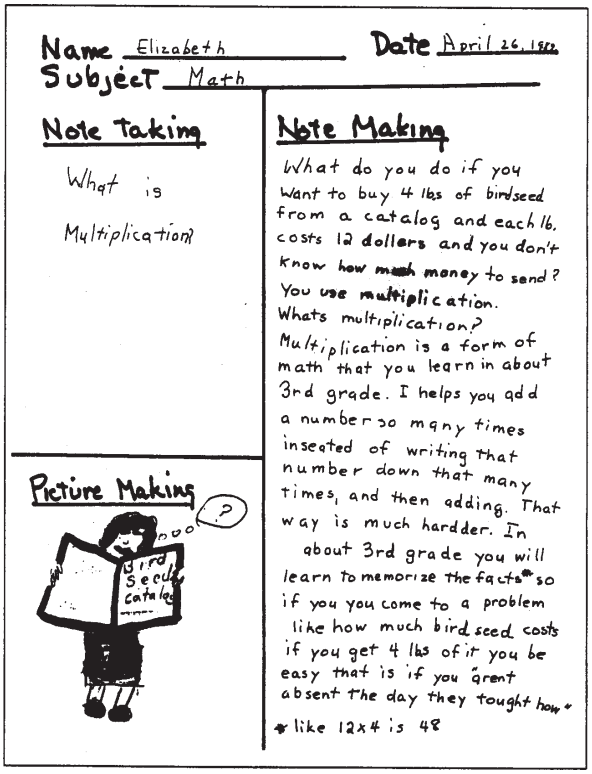
Student writing and journals can take many forms. They can, for example, be fairly structured, as in the note-taking, note-making example on the right, or simply be a general review of the events of the day, as in the example below. Some writing might centre on a particular topic or on one unit of instruction.

An important aspect of assessment is communication between the student and the teacher. The student can ask questions or indicate success or a need for help. The teacher can detect misconceptions or areas that need further instruction.

Teachers can respond with separate notes (e.g., on Post-it Notes) leaving the student's work unmarked. They can add short comments, as in the example below, or longer comments.



Reproduced with permission from *Mathematics Assessment: Myths, Models, Good Questions and Practical Suggestions*, copyright 1991 by the National Council of Teachers of Mathematics.



Reproduced with permission from *Mathematics Assessment: Myths, Models, Good Questions and Practical Suggestions*, copyright 1991 by the National Council of Teachers of Mathematics.

The Grade 3 student who writes about multiplication (see above) appears to understand how multiplication is related to addition. She is able to give a context example of multiplication and seems to have a positive attitude about her work.

The student whose work is shown on the left clearly indicates that he needs help with fraction regrouping, but reports his success on the following day. His teacher is able to stay in touch with his progress.

Log Sheets

Log sheets allow students to record their progress over a period of time, informing the teacher about successes, questions, and problems. Various formats can be used, depending on the nature of the task. Teachers can gain insight into students' questioning techniques, mathematical attitudes, and learning styles.

LOG SHEET

Group members *Ellie, Henry, Lin, Ross*

Investigation title *Consecutive number sums*

Date	Work Done	Questions	Teacher notes
9/19	*Made a plan to list all numbers to 100, begin by dividing up numbers.*	*How far do we have to go?*	Your decision.
		Do we need to make a written report?	You'll need something to show when you make your oral report to the class.
9/20	*Decided it was better to work with numbers than sums (1 + 2 + 3 . . .).*		

A Problem-Solver's Record

Name (s) _____ _____

_____ _____

Problem:

(Tell the problem in your own words.)

Plan:

(List how you might solve it.)

Solve:

(Draw a picture or make a model.)

Check:

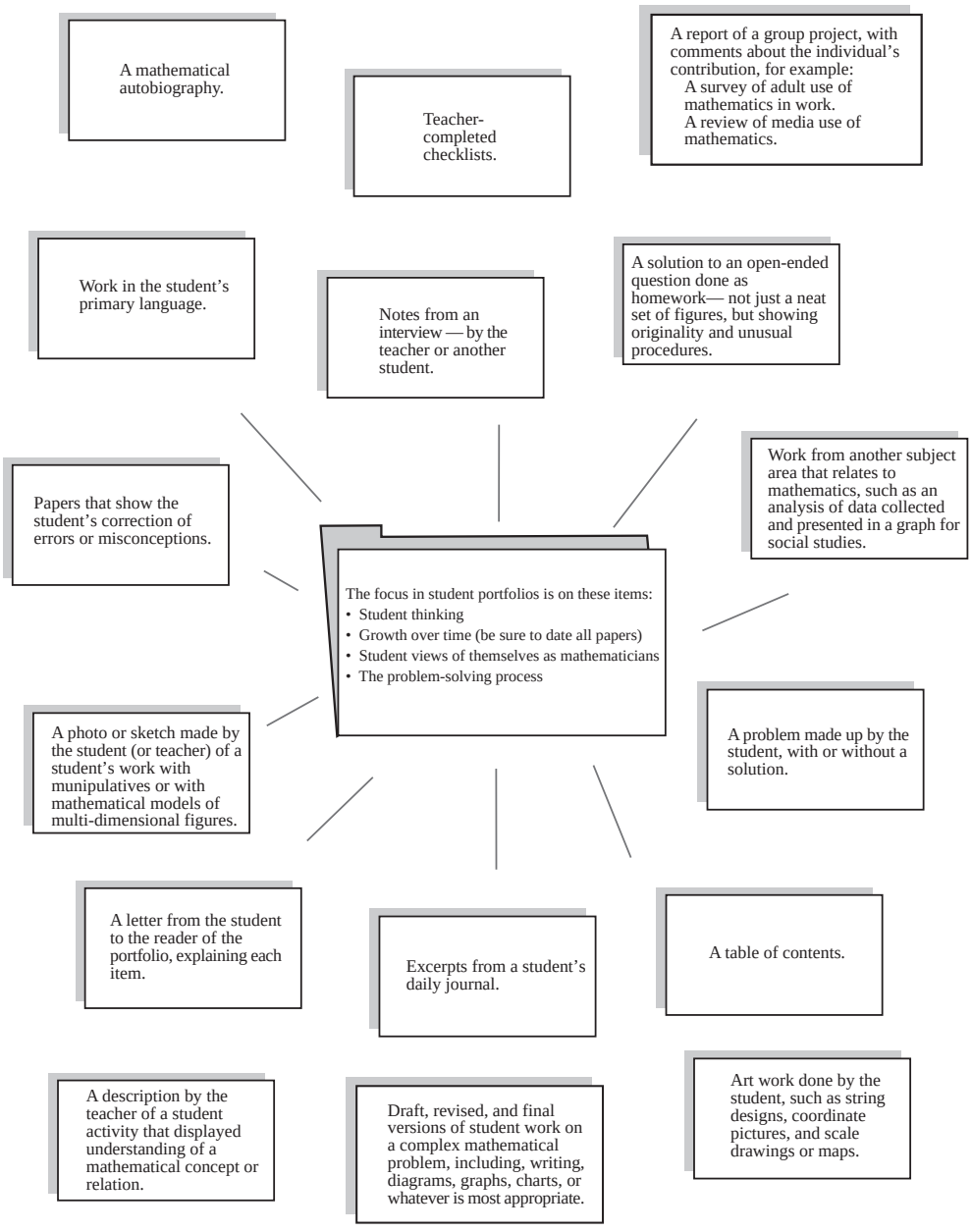
(Write a sentence.)

Math Log

Date	Task or Activity	Success Experienced	Difficulties Encountered

Portfolios

Portfolios are purposeful collections of a student's work that show the student's effort, progress, and achievement over time. The items to be included in a portfolio can be suggested by the teacher or selected by the student. Portfolios provide information to use for a comprehensive assessment of a student's development. Criteria for evaluation can be established for each reporting period. Student entries should be dated to allow the teacher to track each student's development over time.



Interviews

Interviews can provide valuable information about students' understanding, thoughts, and feelings about mathematics. A formal interview often includes a planned sequence of questions that lead to open-ended discussions. Formal, focused interviews can help the teacher diagnose student needs. Informal interviewing and questioning takes place regularly throughout instruction. The following record sheet can be used to record the comments made during a formal interview about attitudes, process, and product.

Questions	Teacher Notes
Attitudes • How did you feel about doing _____? • What do you think about _____? • How do you feel about your answer? • Did you have any new thoughts when _____?	
Process • How did you go about _____? • Tell me another way of doing _____? • How did you know when you were finished? • What would happen if _____? • Why did you _____? • What did not work?	
Product • Tell me about _____. • Tell me what you learned from _____. • What else would you like to know? • Is there anything you would like to change? • How well do you think you've done? • Tell me how or where or when you might use _____? • Is there another possible answer? • What mathematical ideas were in this?	

Observation Sheets

Teachers can assess students through the observation of individual tasks or group activities. At any given time, a wide variety of information is available through observation. It is important to focus the assessment by selecting only a few attributes for each observation.

Daily Observation Sheet

Name (s) _____

Date	Activity	Observed behaviour	Program suggestions

Student _____ Week _____

Observation and Interview Notes:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Math Observation Sheet
September - November

Name _____

Date	Activity	Observation	Instructional Implications

_____

_____

_____

_____

_____

Self-Assessment

Self-assessment promotes the development of responsibility for one's own learning. The following are some sample self-assessment recording forms.

Sample Self-Assessment Checklist

Name _____ Date _____

Directions: For each statement below, answer *Yes*, *No*, or *Not sure*, whichever is closest to your ideas about your own work. There is no right answer. Please answer as honestly as possible. Add comments if you wish.

1. Sometimes I don't know what to do when I start a problem. _____
2. I like mathematics because I can figure things out. _____
3. The harder the problems, the better I like to work on them. _____
4. I usually give up when a problem is really hard. _____
5. I like the memorizing part of mathematics best. _____
6. There is more to mathematics than just getting the right answer. _____
7. I think mathematics is not really useful in everyday living. _____
8. I would rather work alone than with a group. _____
9. I like to do a lot of problems of the same kind rather than have different kinds all mixed up. _____
10. I enjoy mathematics. _____
11. There's always a best way to solve a problem. _____
12. I liked mathematics when I was younger, but now it's too hard. _____

Put an X on this scale where you think you would belong:

I am not good at mathematics.  I am good at mathematics.

Student Self-Evaluation on Problem Solving

Name: _____ Date: _____

Problem: _____

_____

Why was it a problem? _____

_____

How I solved the problem: _____

_____

Did it work? _____

How I would solve a similar problem next time:

_____

_____

Other strategies I could have used: _____

_____

_____

What I learned: _____

_____

_____

Name _____ Date _____

About Me and My Math

What I did today	
How I did it	
Who I worked with	
What I did well	
What I want to do better	

Checklists

Checklists make it easier to collect and organize information. As a teacher scans the room, he/she can easily observe who is capable of doing a task and who is not. Collections of checklists, along with other information, can be useful in developing a learning profile of a child that indicates growth over time. The following is an example of a checklist developed to collect information about students' growth over time.

Math Problem-Solving Class Checklist

Names	Date		Date		Date		Date		Date	
	Strategy	Comments	Strategy	Comments	Strategy	Comments	Strategy	Comments	Strategy	Comments

Strategies:

1 Act it out
2 Draw a diagram
3 Make a model
4 Look for a pattern
5 Guess and Check
6 Number sentences
7 Classify information
8 Make a list, table, graph
9 Break problem into parts
10 Work backwards
11 Use logic
12 Simpler problem

Others to suit situation:

13 _____
14 _____
15 _____

Directions:

Record the number of the strategy used. Add comments as appropriate.

Performance Tasks

Performance assessment is the gathering of information about student learning based on students demonstrating what they can do. It values process as well as product and incorporates a variety of strategies, from observation to self-assessment.

Performance assessment is a powerful classroom tool because it:

- integrates assessment and instruction
- may occur at any point during an activity
- involves student and teacher collaboration
- includes students in assessment and evaluation
- values both process and product

"Considerations for Designing Performance Assessment Tasks" (see below) and the two planning guides outlined on the right are all designed to help teachers plan for the effective incorporation of performance assessment.

Planning Guide 1

Activity
- states clearly what is to be done

Preparation
- the knowledge and skills necessary to complete the activity are developed
- a time line and evaluation criteria are established

Guidelines for students
- developed with students to provide specific directions for successfully completing an activity (perhaps using a checklist)
- connected to the evaluation criteria

Evaluation criteria
- basis for evaluation of process and/or product
- may incoporate opportunities for reflection, self-assessment, and peer assessment

Variations and extensions
- provide alternatives to include all students (special needs, ESL)

Considerations for Designing Performance Assessment Tasks

What knowledge, skills, and attitudes will students demonstrate?

How will this activity enhance the class curriculum?

Will the assessment of performance be formal or informal, structured or unstructured?

Who will design a structured activity?
- teacher
- teacher and students together through collaboration
- students deciding on the format and presentation as part of their project

How can the activity be developed?
- consider individual or group involvement
- consider individual learning styles
- decide on materials, equipment, people

What time factors may be involved?

Who will assess and evaluate the process and product(s)?

How will the process and product(s) be evaluated?

How can the information from the process and the product(s) be used for further evaluation, reporting, and planning instruction?
- self-assessments for conferences and portfolios
- reflecting on goals, revising action plans, setting new goals
- putting the task, with evaluation criteria and products, in a portfolio

Planning Guide 2

Reason(s) for assessment
- Identify purpose and decision-makers.

Performance to be evaluated
- Specify the content and process focus of the assessment.

Select exercises and events
- Plan how students will demonstrate what they can do.
- Decide how the information about student learning will be gathered.

Performance rating plan
- Determine who is to evaluate.
- Decide on the recording method.

Appendix E

Acknowledgments

Many people contributed their expertise to this document. The project was co-ordinated by Neil Whitmore of the Curriculum Branch working with Ministry personnel and our partners in education. In addition, educators from the Western Canadian Consortium worked together to create the learning outcomes, which will be shared across B.C., Alberta, Saskatchewan, Manitoba, the Yukon, and the Northwest Territories. We would like to thank all who participated in the process.

MATHEMATICS OVERVIEW TEAM

Ann Anderson
University of British Columbia

Leslee Francis-Pelton
University of Victoria

Harvey Gerber
Simon Fraser University

Keith Gray
Business Council of British Columbia

Ivan Johnson
B.C. Association of Mathematics Teachers

Marie Klawe
University of British Columbia

Micheal Koseruba
Colliers Macaulay Nicolls Inc.

Jean MacLeod
Vancouver Community College

LEARNING OUTCOMES WRITING TEAM

Suzanne Cairney
School District No. 42 (Maple Ridge-Pitt Meadows)

Steve Cairns
School District No. 41 (Burnaby)

Karen Chong
School District No. 42 (Maple Ridge-Pitt Meadows)

Keith Chong
University of British Columbia

Grace Fraser
Retired Teacher

Eric Hiob
B.C. Institute of Technology

Klaus Hoechsmann
University of British Columbia

Ivan Johnson
School District No. 41 (Burnaby)

Jack Kinakin
School District No. 9 (Castlegar)

Carryl Koe
School District No. 37 (Delta)

Jan Laidlaw
School District No. 35 (Langley)

Jim Nakamoto
School District No. 39 (Vancouver)

Tom O'Shea
Simon Fraser University

Garry Phillips
School District No. 40 (New Westminster)

Gillian Rudge
School District No. 44 (North Vancouver)

Appendix E: Acknowledgments

IRP Components

Lesley Carnogursky
School District No. 85 (Vancouver Island North)

Karen Chong
School District No. 42 (Maple Ridge-Pitt Meadows)

Steve Halliday
School District No. 69 (Qualicum)

Hannu Makinen
School District No. 37 (Delta)

Debbie Sturgeon
School District No. 38 (Richmond)

Partner Review

Pat Barret
School District No. 36 (Surrey)

Grace Fraser
Retired Teacher

Barry Irvine
Ocean Construction Supplies Ltd.

Carryl Koe
School District No. 37 (Delta)

David Leeming
University of Victoria

Bill McNaughton
Ladner Downs, Barristers and Solicitors

Jim Sherrill
University of British Columbia

Nadine Steel
School District No. 2 (Cranbrook)

Robert Whiteley
School District No. 68 (Nanaimo)

IRP REVIEWS

Fred Benallick
School District No. 29 (Lillooet)

R.B. Black
School District No. 33 (Chilliwack)

Art Blackwell
School District No. 24 (Kamloops)

Brenda Brierley
School District No. 23 (Central Okanagan)

Spence Bryson
School District No. 24 (Kamloops)

Lorne Bura
School District No. 23 (Central Okanagan)

Linda D'Entremont
School District No. 24 (Kamloops)

Michelle Dyck
School District No. 69 (Qualicum)

Eileen Eby
School District No. 61 (Greater Victoria)

Sonia Engstad
School District No. 61 (Greater Victoria)

Doug Evans
School District No. 23 (Central Okanagan)

Sandy Ewankiw
School District No. 11 (Trail)

Vicki Frandsen
School District No. 69 (Qualicum)

Thor Fredrikkson
School District No. 24 (Kamloops)

Karen Frieson
School District No. 69 (Qualicum)

Sandy Horner
School District No. 29 (Lillooet)

John Horstead
School District No. 40 (New Westminster)

Debbie Jones
School District No. 40 (New Westminster)

Grace Jones
School District No. 33 (Chilliwack)

Mas Kanegae
School District No. 40 (New Westminster)

Heather Kelleher
School District No. 40 (New Westminster)

Lori LaFrance
School District No. 23 (Central Okanagan)

Ron Langevin
School District No. 40 (New Westminster)

Dianne McAleese
School District No. 23 (Central Okanagan)

Sylvia McGregor
School District No. 11 (Trail)

Paul McKay
School District No. 40 (New Westminster)

Ralph Motzek
School District No. 69 (Qualicum)

Barb Nutini
School District No. 23 (Central Okanagan)

R. Pears
School District No. 61 (Greater Victoria)

Cheryl Piercy
School District No. 69 (Qualicum)

Beverley Richings
School District No. 29 (Lillooet)

Bobby Seed
School District No. 29 (Lillooet)

Leona Tank
School District No. 29 (Lillooet)

Maureen Tompkins
School District No. 40 (New Westminster)

Sandra Turner
School District No. 23 (Central Okanagan)

Debbie Watteyne
School District No. 29 (Lillooet)

Florence Westbrook
School District No. 29 (Lillooet)

Harold Willers
School District No. 33 (Chilliwack)

Valerie Williams
School District No. 24 (Kamloops)

B.C. ASSOCIATION OF MATHEMATICS TEACHERS STANDING CURRICULUM REVIEW COMMITTEE

Karen Chong
School District No. 42 (Maple Ridge-Pitt Meadows)

Keith Chong
University of British Columbia

Ian DeGroot
School District No. 44 (North Vancouver)

David Ellis
School District No. 39 (Vancouver)

Sue Haberger
School District No. 43 (Coquitlam)

Rennie Hollie
School District No. 36 (Surrey)

Ivan Johnson
School District No. 41 (Burnaby)

Carryl Koe
School District No. 37 (Delta)

Mark Mahovlich
School District No. 63 (Saanich)

Kanwal Neel
School District No. 38 (Richmond)

Tom O'Shea
Simon Fraser University

Garry Phillips
School District No. 40 (New Westminster)

Gillian Rudge
School District No. 38 (Richmond)

Jim Swift
School District No. 41 (Burnaby)

Stella Tossell
School District No. 39 (Vancouver)

John Klassen
School District No. 45 (West Vancouver)

Appendix F

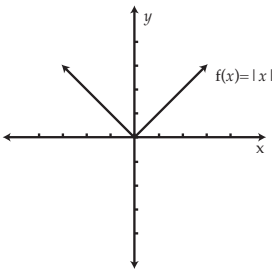
Glossary

ABOUT APPENDIX F

This appendix provides an illustrated glossary of terms used in this Integrated Resource Package.

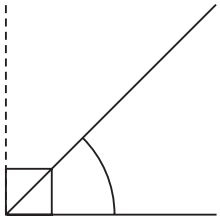
The terms and definitions are intended to be used by readers unfamiliar with mathematical terminology. For a more complete definition of each term, refer to a mathematical dictionary such as the *Nelson Canadian School Mathematics Dictionary* (ISBN 17-604800-6).

absolute-value
A positive number that has the same magnitude as a given number.



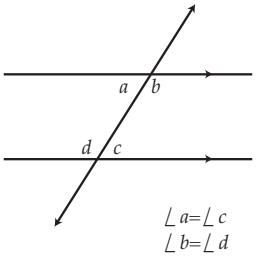
absolute-value function
A function that assigns its absolute value to a given number x:

$$f(x) = |x|$$



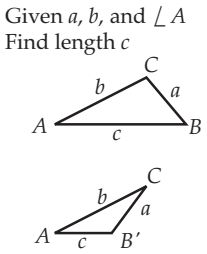
acute angle
An angle whose measure is between 0° and 90°.

algorithm
A step-by-step procedure for solving a problem.



alternate interior angles
A transversal cutting across two or more parallel lines forms equal angles on opposite sides of the transversal and between the parallel lines.

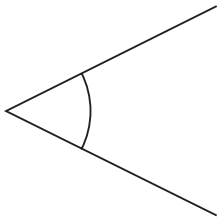
altitude
A line segment giving the height of a polygon, polyhedron, cone, cylinder, or other geometric figure.



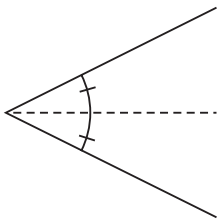
ambiguous case
A case in the solution of triangles in which the known values can give two possible solutions or no solution.

amplitude
The maximum displacement from a reference level in either a positive or negative direction.

analytic geometry or coordinate geometry
A form of geometry in which lines, curves, and other shapes are represented by equations indicating their position in a coordinate system.



angle
A figure formed by two rays or two line segments with a common endpoint (vertex).



angle bisector
A line that divides an angle into two equal parts.

arc
A continuous part of a curve or circle.

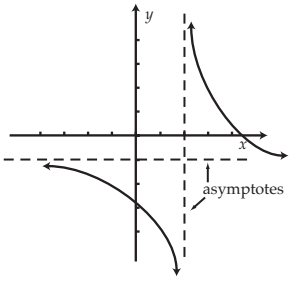
arithmetic operation
Addition, subtraction, multiplication, and division.

arithmetic sequence
A sequence in which each term (except the first) differs from the previous one by a constant amount, the common difference:

$t_n = a + (n - 1)d$ = general term
a = first term
d = common difference
n = number of terms

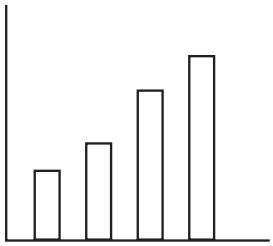
arithmetic series
The sum of the first n terms of an arithmetic sequence.

$$S_n = \frac{n}{2}(2a + (n - 1)d)$$
or
$$S_n = \frac{n}{2}(a + l)$$



asymptote
A line related to a given curve such that the distance from the line to a point on the curve approaches zero as the distance of the point from an origin increases without bound.

axis of symmetry
A line associated with a geometric figure such that every point on one side of the line has a corresponding point on the other side.

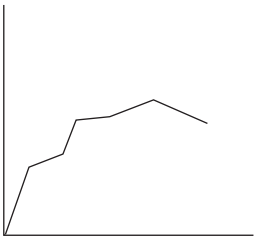


bar graph
A graph using parallel bars (vertical or horizontal) which are proportional in length to the data they represent.

base
A given number that is expressed as exponential or logarithmic. For example:

4^7: base is 4
$\log_{10}6$: base is 10

bisect
To divide into two equal parts.



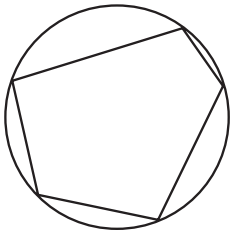
broken-line graph
A graph using line segments to join the plotted points to represent data.

Cartesian (rectangular) coordinate system
A coordinate system in which the position of a point is determined by its distance from perpendicular reference lines (axes).

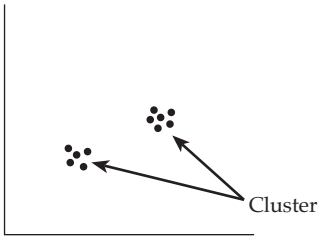
central angle
An angle in a circle between two radii.

chord
A straight-line segment joining any two points on a curve or surface.

circumference
The perimeter of a circle.



circumscribed
A relationship in which one figure encloses another as in a polygon circumscribed by a circle.



cluster
A number of similar items (points) grouped closely together on a graph.

coefficient
A numerical or constant multiplier of the variable in an algebraic term. For example:

$4x$: coefficient is 4

collinear
Lying on the same line.

combination
The number of selections of r different items from n distinguishable items when the order of selection is ignored.

$$_nC_r = \frac{n!}{r!\,(n-r)!}$$

combination data
Data that consist of both first-hand and second-hand data.

common factor (CF)
A number that is a factor of two or more numbers. For example:

3 is a common factor of 6 and 12

common fraction
A number that describes part of a whole or part of a group and is expressed as a ratio, where the numerator and denominator are both integers, and the denominator cannot be 0. For example:

$\frac{4}{5}$

compasses, pair of
An instrument for drawing circles or arcs.

complementary angles
Two angles whose sum is 90°.

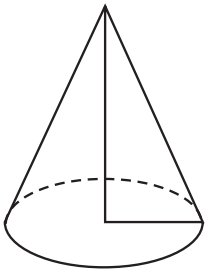
completing the square
A method of solving quadratic equations by replacing a quadratic expression with a form in which the variable appears only in a squared term.

complex fraction
A fraction in which the numerator or the denominator, or both, contain fractions.

composite number
A number that has two or more prime factors. For example:

$12 = 2 \times 2 \times 3$

compound interest
The interest that accumulates over a given period when each successive interest payment is added to the principal in order to calculate the next interest payment.



cone
A 3-D object generated by rotating a right triangle about one of its legs.

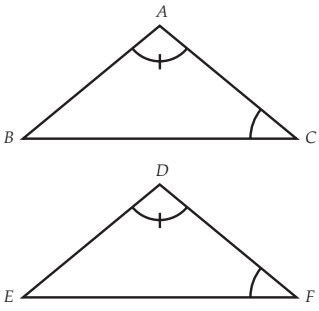
confidence interval(s)
An interval that is believed, with a preassigned degree of confidence, to include the particular value of some parameter being estimated.

congruent
Having identical shape and size.

constant
A fixed quantity or numerical value.

converse (of a theorem)
A theorem obtained by interchanging the premise and conclusion of a given theorem.

coordinates
A set of numbers that uniquely identifies the position of a point relative to a coordinate system.



corresponding angles and corresponding sides
Angles or sides that have the same relative position in geometric figures.

cosine law (law of cosines)
A formula used for solving triangles in plane geometry.

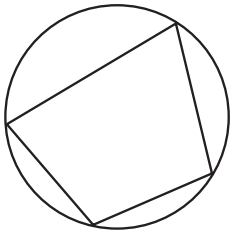
$$c^2 = a^2 + b^2 - 2ab \cos C$$

cosine (function)
See *primary trigonomic functions*.

coterminal angles
Angles that are rotations between the same two lines, termed the initial and terminal arms. For example:

$20°$, $-340°$, $380°$ are coterminal angles

cube
Polyhedron with six identical square faces.



cyclic (inscribed) quadrilateral
A quadrilateral circumscribed by a circle so that all its vertices lie on the circumference of the circle.

cylinder
A 3-D object with two congruent circular bases that is obtained by rotating a rectangle about one of its sides.

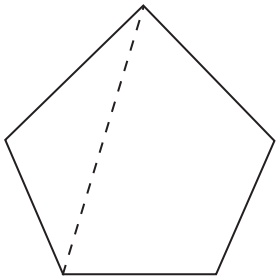
decimal fraction
A fraction expressed in decimal notation. For example:

$\frac{1}{4}$ expressed as decimal fraction is 0.25

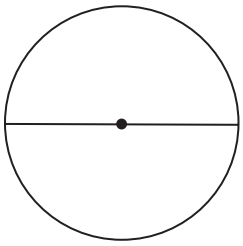
deductive reasoning
A valid argument in which the conclusion follows from the premises.

degree
The highest power or sum of powers in any term of a given polynomial or equation. For example:

$y = mx + y$ is of degree 1, while $y = x^2$ and $x + 2xy + y = 0$ are degree 2.



diagonal
Line segment joining two non-adjacent vertices in a polygon or two vertices of a polyhedron not on the same surface.



diameter
A chord that passes through the centre of a circle.

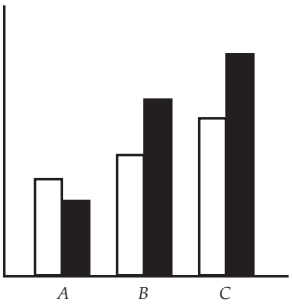
difference of squares
A polynomial expression of the form $x^2 - y^2$ that can be factored into conjugate factors: $(x - y)(x + y)$.

distance formula
The formula used in coordinate geometry to find the distance between two points. For example:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

where point A has coordinates (x_1, y_1) and point B (x_2, y_2).

domain
The set of values that can be assumed by the independent variable of a function. Usually the x-values of a function.



double bar graph
A bar graph that uses bars to represent two sets of data visually.

edge
The straight line segment that is formed where two faces of a polyhedron meet.

equation
A statement that two mathematical expressions are equal, such as:

$$3x + y = 7$$

equidistant
Having equal distances from some specified object, point, or line.

estimate
To approximate the value or size of something, for example, objects, area, volume, or total.

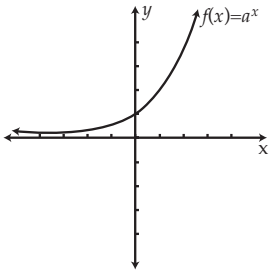
Euclidean geometry
Geometry based on the definitions and axioms set out in Euclid's Elements.

event
A subset of the sample space of all possible outcomes of an experiment.

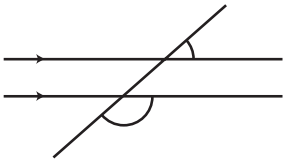
experimental probability
The numerical measure of what actually happens in an experiment; actual outcomes ÷ possible outcomes.

exponent
The number that indicates the power to which the base is raised. For example:

3^4: exponent is 4



exponential function
A function of the form $f(x) = a^x$ having variables expressed as exponents.



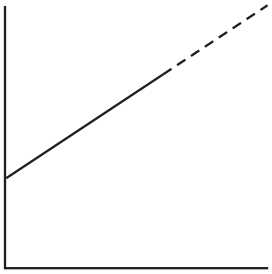
exterior angles on the same side of the transversal
A transversal of two parallel lines forms two supplementary exterior angles.

extraneous root
A number obtained when solving an equation, which is not a root of the equation to be solved.

For the equation $1 - \sqrt{x-1} = x$
there is 1 root, $x = 1$
This can also be solved in the following manner:

	$1 - \sqrt{x-1} = x$
subtract "1"	$-\sqrt{x-1} = x - 1$
square both sides	$x - 1 = x^2 - 2x + 1$
combine like terms	$0 = x^2 - 3x + 2$
solve by factoring	$0 = (x-2)(x-1)$
	$x = 2$ and $x = 1$

2 is an extraneous root (does not work when substituted into the original equation)



extrapolate
To estimate a value by following a pattern and going beyond values already known.

extreme values
The highest and lowest numbers in a set.

face
The plane surface of a polyhedron.

factor theorem
For a given polynomial in x, $x - a$ is a factor if the value of the polynomial is zero when $-a$ replaces x throughout.

factor(s)
Numbers multiplied to produce a specific product. For example:

$2 \times 3 \times 3 = 18$: factors are 2 and 3; $(x-2)$ and $(x+1)$ are factors of $x^2 + x - 2$

first-hand data
Data collected by an individual directly from observations or measurements.

flip
A term used in transformations to describe the result of a reflection.

fractals
A geometric shape that is self-similar and has fractal dimension.

frequency diagram
A diagram used to record the number of times an event occurs.

function
$y = f(x)$ the set of all ordered pairs (x,y) with x belonging to the domain x and y belonging to the range Y. No two pairs have the same x-value.

fundamental counting principle
A general rule that states that if a choice can be made in x different ways and for each of these choices a second choice can be made in y different ways, then the choices can be made in xy different ways.

general form
The general equation of the n^{th} degree is the polynomial equation.

$$a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_{n-1}x + a = 0$$

geometric sequence
A sequence in which the ratio of each term (except the first) to the preceding term is a constant; the common ratio.

$t_n = ar^{n-1}$ = general term
a = first term
r = common ratio
n= number of terms

geometric series
The sum of the first n term of a series.

$$S_n = \frac{a(1 - r^n)}{1 - r}$$

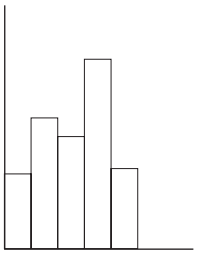
greatest common factor (GCF)
The largest factor that two or more numbers have in common. For example:

12 and 18: GCF = 6

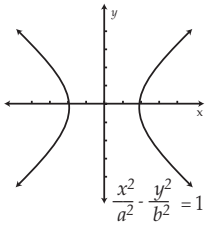
Heron's formula
Area of triangle:

$A = \sqrt{s\,(s-a)(s-b)(s-c)}$

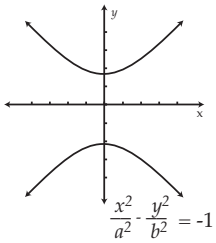
where a, b, and c are the sides of the triangle and s is half the sum of the lengths of the sides of the triangle.



histogram
A bar graph showing the frequency in each class using class intervals of the same length.



hyperbola
A curve with two branches formed from the intersection of a plane and a circular conical surface.



hypotenuse
The side opposite the right angle in a right triangle.

hypothesis
A statement that may be true, but for which a proof (or disproof) has not been found.

identity
A statement that two mathematical expressions are equal for all values of their variables.

improper fraction
A fraction whose numerator is greater than its denominator.

inequality
A mathematical statement that one expression is greater than or less than the other. For example:

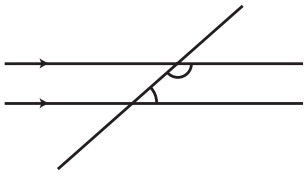
$x > y$ means that x is greater than y; and $x < y$ means that x is less than y

infinite geometric series
An infinite series of the form $a + ar + ar^2 + \ldots + ar^{n-1} + \ldots$. If $|r| < 1$, then the sum of the series is:

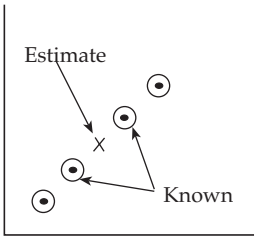
$$S = \frac{a}{1 - r}$$

inscribed angle
An angle formed by two chords that intersect on the curve, each with an endpoint at the vertex of the angle.

integer
The positive and negative whole numbers 0, ±1, ±2, ±3 . . .



interior angles on the same side of the transversal
The transversal of two parallel lines forms interior supplementary angles.



interpolate
To calculate or estimate values between two known values in a set of data.

intersection
The point at which two lines cross each other.

interval
A set of all the real numbers between two given numbers.

inverse operations
Operations that counteract each other. For example, addition and subtraction are inverse operations.

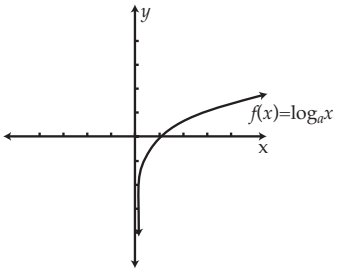
irrational number
A number that cannot be expressed either as a quotient of two integers or as a repeating or terminating decimal, for example, $\sqrt{2}$, π, e are irrational numbers.

irregular
Lacking in symmetry or pattern.

isosceles triangle
A triangle that has two sides equal and the third unequal. (The angles opposite the equal sides are also equal.)

linear function
A polynomial function of degree one, the graph of which is a straight line. For example:

$f(x) = a_0 + a_1x$, where a_0 and a_1 are constants



logarithmic function
The function of the type $f(x) = \log_a x$ where a is a positive constant, $a \neq 1$.

lowest common multiple (LCM)
The lowest number that is a multiple of two or more numbers. For example:

3, 4, 6: LCM = 12

matrix
A rectangular array of numbers. For example:

$$\begin{bmatrix} 3 & 4 \\ -2 & 5 \end{bmatrix} \qquad \begin{bmatrix} 1 \\ 7 \\ 2 \end{bmatrix}$$

2×2 matrix $\qquad$ 3×1 matrix

maximum point (or value)
The greatest value of a function.

mean
The sum of numbers in a set divided by the number of numbers in that set; sometimes referred to as the average.

median
The middle number in a set of numbers arranged in rank order.

minimum point (or value)
The lowest value of a function.

mixed number
A number that is expressed as the sum of a whole number and a fraction. For example:

$3\frac{2}{5}$

mode
The number that occurs most frequently in a set of data.

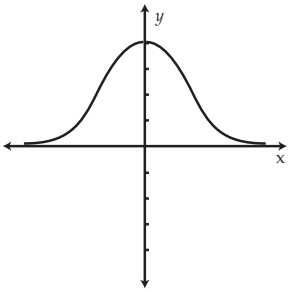
monomial
An algebraic expression that is the product or a quotient of single variables and a constant.

multiple
The result of the repeated addition of a number. For example:

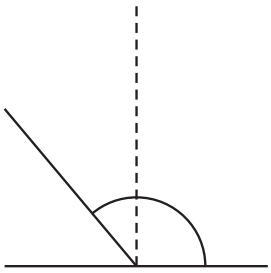
4, 8, 12, 16: are multiples of 4

natural numbers (counting numbers)
Positive integers (1, 2, 3, 4. . . .)

net
A flat diagram consisting of plane faces arranged so that it may be folded to form a solid.



normal distribution curve
A distribution curve that is symmetric with respect to the vertical axis. Often described as bell-shaped.

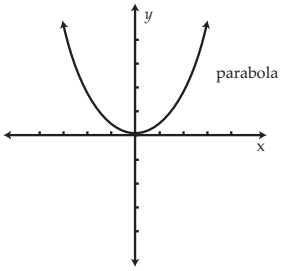


obtuse angle
An angle whose measure is between 90° and 180°.

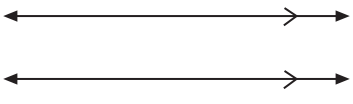
ordered pairs
A pair of numbers (x, y) indicating the x- and y-coordinates of a point on a graph.

ordinal number
A number designating the place occupied by an item in an ordered sequence (e.g., first, second, and third).

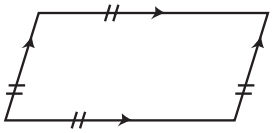
origin
The point in a coordinate system at the intersection of the axes.



parabola
The intersection of a conical surface and a plane parallel to a line on the surface.



parallel lines
Lines in the same plane that never meet.



parallelogram
A quadrilateral with opposite sides parallel and equal in length.

percentage
A fraction or ratio expressed as part of 100.

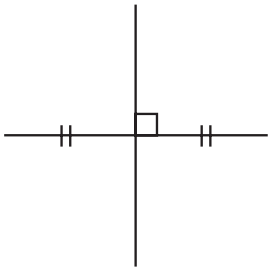
percentile
One of the division points that divides a set of ranked data into one hundred equal points.

perimeter
The length of the boundary of a closed figure.

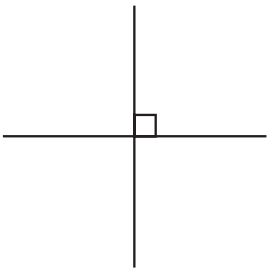
period
The interval taken to make one complete oscillation or cycle.

permutation
The number of ways of selecting $r \leq n$ objects from n distinguishable objects without replacement when order of selection is important.

$$_nP_r = n(n-1)(n-2)\ldots(n-r+1)$$

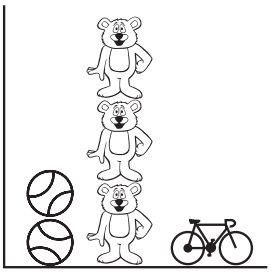


perpendicular bisector
A line that intersects a line segment at a right angle and divides the line segment into two equal parts.

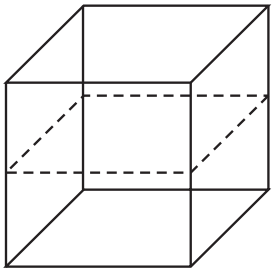


perpendicular line
Two lines that intersect at a right angle.

phase shift
For a particular value of the independent variable of a periodic function, the part or fraction through which the variable has advanced.



pictograph
A graph that uses pictures or symbols to represent similar data.



plane of symmetry
A 2-D flat surface that cuts through a 3-D object, forming two parts which are mirror images.

polygon
A closed figure formed by three or more line segments that do not intersect other than at the vertices.

polyhedron
A 3-D figure having polygons as faces.

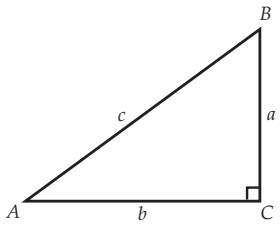
polynomial
A mathematical expression that is a sum of terms, each term being a product of a constant and a non-negative (or zero) power of a variable or variables. For example:

$$3x^3 - 2x + .5x^2 + 6$$

population
A group of items from which a sample is taken for statistical measurement.

power
A number written in exponential form. For example:

$$4 \times 4 \times 4 \times 4 \times 4 = 4^5$$



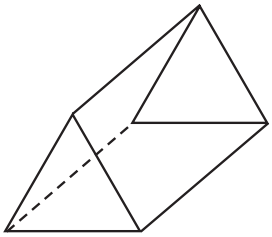
Sine A = $\frac{a}{c}$

primary trigonometric functions
sine A = $a/c = opp/hyp$
cosine A = $b/c = adj/hyp$
tangent A = $a/b = opp/adj$
Functions of angles defined, for an acute angle, as ratios of sides in a right triangle.

prime
A number having exactly two factors, 1 and itself.
For example: 2, 3, 5, 7, 11 are prime numbers.

prime factorization
A composite number expressed as a product of prime factors.
For example:

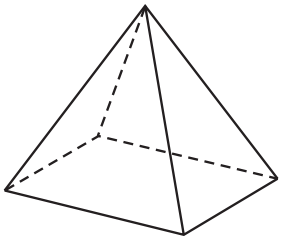
$$36 = 2 \times 2 \times 3 \times 3$$



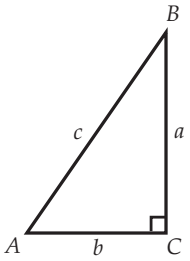
prism
A solid with two parallel and congruent bases in the shape of polygons; the other faces are parallelograms.

probability
A measure associated with an event, A, and denoted $P_r(A)$ that takes a value such that $0 \leq P_r(A) \leq 1$.

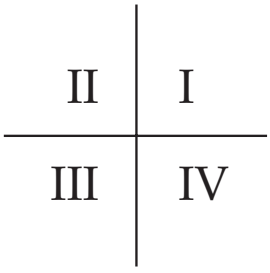
product
A number resulting from multiplication.



pyramid
A polyhedron with one polygonal base and the same number of triangular faces as there are sides on the base.



Pythagorean theorem
In a right-angled triangle, the sum of the squares of the lengths of the sides containing the right angle is equal to the square of the hypotenuse ($a^2 + b^2 = c^2$).

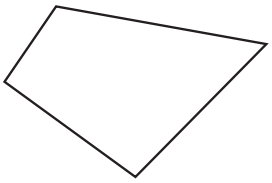


quadrant
One of four regions formed by two intersecting perpendicular lines.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

quadratic formula
A formula used to determine the roots of a quadratic equation.

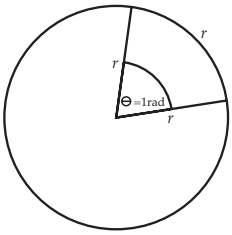
quadratic function (see parabola)
A polynomial function of degree two of the form $f(x) = ax^2 + bx + c$, where $a \neq 0$.



quadrilateral
A polygon with four sides.

quartile
The value between consecutive intervals in a frequency distribution of four intervals containing one-quarter of the population.

quotient
A number resulting from division.



radian
Equal to the central angle subtended by an arc of unit length at the centre of a circle of unit radius.

radical
The root of a quantity as indicated by the sign $\sqrt{\ }$.

radius
A line segment that joins the center of a circle and a point on the circumference.

range
The difference between the extremes in a set of numbers (e.g., 20 to 35: range is 15); the set of values a function takes on.

rank ordering
The order according to some statistical characteristic.

rate
A comparison of two measurements with different units. For example, the speed of an object measured in kilometres per hour.

ratio
A comparison of two numbers. For example:

3:7

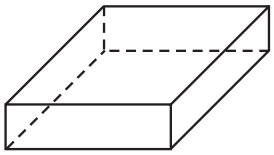
rational expression
The quotient of two polynomial functions. The denominator cannot be 0.

rational number
A real number that can be expressed in the form of a fraction (denominator $\neq 0$), with the numerator and denominator being whole numbers.

rationalize the denominator
Transforming a term involving radicals and fractions into an equivalent fraction with the expression for the denominator free of radicals. For example:

$$\frac{4}{(2-\sqrt{7})} = \frac{4(2+\sqrt{7})}{-3}$$

reciprocal
The number or expression produced by dividing 1 by a given number or expression.

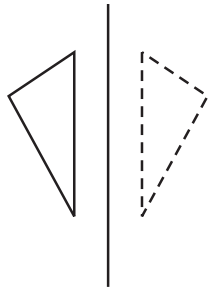


rectangular prism
A prism whose bases are congruent rectangles.

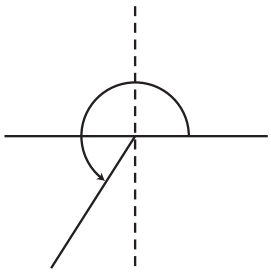
recursive definition
A function or sequence that is defined by specifying its first term and an algorithm by which you derive any term from its predecessor. For example:

Fibonacci sequence, $a_1 = a_2 = 1$ and $a_{n+1} = a_n + a_{n-1}$, $n \geq 2$

reference angle
Angles that have the same absolute values for their trigonometric function.



reflection
A flip transformation of an object in a mirror or over a reflection line.



reflex angle
An angle whose measure is between 180° and 360°.

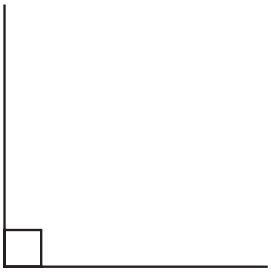
relation
An association between, or property of, two or more objects.

remainder theorem
A polynomial P(x) divided by x-h has a remainder equal to P(h).

repeating decimal
A decimal in which one or more digit(s) repeat without termination. For example:

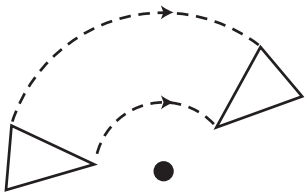
$$\frac{3}{11} = 0.272727\ldots = 0.\overline{27}$$

resultant
The sum of two or more vectors.



right angle
An angle whose measure is 90°.

root of an equation
A number that, when substituted for the variable in the equation, reduces it to zero.



rotation
A turn transformation of an object about a fixed point.

rounding
A process to follow when making an approximation to a given number by using fewer significant figures.

sample
A selection from a population.

scalar
A quantity that can be completely specified by a number and unit and therefore has magnitude only.

second-hand data
Data not collected directly by the researcher. For example, encyclopedia.

semicircle
Half a circle; either of the two parts of a circle cut off by a diameter.

sequence
A succession of terms $a_1, a_2, a_3 \ldots$ formed according to some rule or law.

series
The indicated sum of the terms of a sequence.

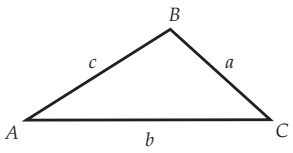
SI notation
Abbreviation for *Système International d'Unites*—International System of Units—kilogram, second, ampere, Kelvin, candela, mole.

side
Line or surface forming a border or face of an object.

sigma notation (summation notation)
The sign Σ (Greek capital sigma) used to indicate summation of a set or sequence of numbers or variables.

simple interest
Interest calculated on the principal only.

sine (function)
See *primary trigonometric functions.*

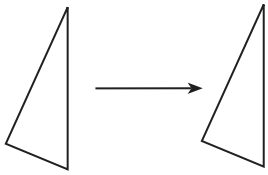


sine law (law of sines)
A formula used for solving triangles in plane trigonometry.

$$\frac{a}{\text{Sin } A} = \frac{b}{\text{Sin } B} = \frac{c}{\text{Sin } C}$$

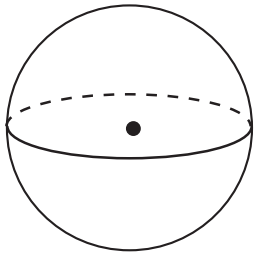
skeleton
A representation of the edges of a polyhedron.

skip counting
Counting by multiples of a number. For example, 2, 4, 6, 8.



slide
A linear transformation of an object or figure.

slope–intercept form
A linear equation of the form $y = mx + b$ where m = slope and $b = y$-intercept.

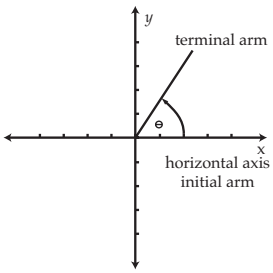


sphere
A solid whose surface is all points equidistant from a centre point.

square root
The square root of a number is the positive number that when multiplied by itself produces that number. For example: 5 is the square root of 25; $|x|$ is the square root of x^2.

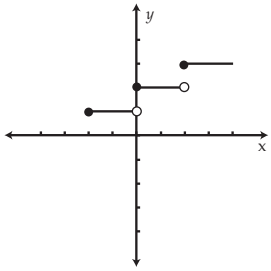
standard deviation
The positive square root of the variance.

standard form
A simple form of an equation; a form in which the equation is usually written.



standard position
An angle positioned such that the initial arm is the positive horizontal (x) axis. Counter clockwise rotation is a positive angle.

stem-and-leaf plot
Information tabulated so that the last digit is the leaf and the digit(s) in front are the stem.



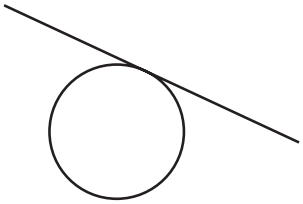
step function
A function that jumps from one value to another without taking on any of the intermediate values.

straight angle
An angle whose measure is 180°.

supplementary angles
Two angles whose sum is 180°.

symmetrical
Having either rotational or plane symmetry.

tangent (function)
See *primary trigonometric functions.*



tangent (of a curve)
A line that touches a curve at only one point (the point of tangency).

tangram
A square cut into seven shapes: two large triangles, one medium triangle, two small triangles, one square, and one parallelogram.

term
Part of an equation or mathematical expression as in a polynomial, the terms are the expressions that are added together.

terminating decimal
A decimal number where the digits do not indefinitely repeat.

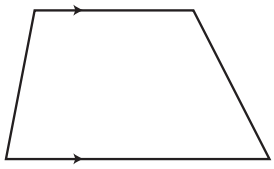
tessellation
A repeated pattern of a geometric figure that will completely cover a surface.

theoretical probability
The numerical measure of the likelihood that an event will happen; favourable outcomes ÷ possible outcomes.

transformation
A change in the form of a mathematical expression or figure, as by rearranging the terms.

translation
A slide transformation of an object or figure.

transversal
A line that intersects two or more lines at different points.



trapezoid
A quadrilateral with exactly two parallel sides that are unequal in length.

tree diagram
A pictorial way of representing combinations of things.

trigonometry
The branch of mathematics concerned with solving triangles by using trigonometric functions, arithmetic, algebra, and geometry.

trinomial
A polynomial that has three terms. For example:

$$ax^2 + bx + c$$

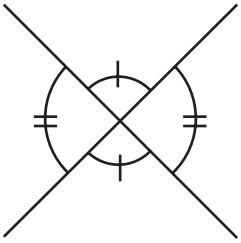
turn
A rotation transformation of an object or figure.

unit vector
A vector that has the length (or magnitude) of one unit.

variable
A mathematical entity that can stand for any of the members of a given set.

vector
A directed line segment used to describe a quantity that has direction as well as magnitude.

vertex (pl: vertices)
The point of intersection of the sides of a polygon or faces of a solid.



vertically opposite angles
Opposite (and equal) angles resulting from the intersection of line segments.

whole number
A positive integer or zero. For example: 0, 1, 2, 3, 4.

***x*-intercept**
The point at which a curve cuts the *x*-axis (horizontal axis).

y-intercept
The point at which a curve cuts the y-axis (vertical axis).

zero (root)
If, for a function $f(x)$, the value $x = a$ is such that $f(a)=0$, then a is a zero of the function; where the graph of a function meets the x-axis.

Appendix G

Mathematics K to 7

About Appendix G

This appendix contains a series of examples designed to help teachers understand the prescribed learning outcomes for Mathematics K to 7.

The prescribed learning outcomes have been paired with examples that illustrate the types of activities an average student should be able to complete at a given cluster or grade level.

- All prescribed learning outcomes for Mathematics K to 7 are listed.
- In some cases an illustrative example may apply to more than one learning outcome.
- Some outcomes have more than one example.
- Some outcomes (such as those that require a simple recall of fact) have not been further clarified with an example.

Please note that these illustrative examples are not intended to be used for assessment of student performance. See Appendix D for samples of assessment and evaluation in Mathematics K to 7.

NUMBER *(Number Concepts)*

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• count orally by 1s, 2s, 5s, and 10s to 100	► Count the number of eyes in the classroom, counting by 2s. Count the fingers of the people at your table, counting by 5s or 10s.
• estimate and count objects in a set (0 to 50) and compare estimates to the actual number	► Given a jar full of marbles, estimate how many marbles are in the jar, then count them. How does your estimate compare with your actual count? Given a different jar, estimate how many marbles will fit inside it. Did knowing the contents of the first jar help you make your guess? Why or why not?
• recognize, build, compare, and order sets of objects (0 to 50) using both comparative and numerical terms	► Order these cards from the greatest number to the least number. a seven a.____ b ten b.____ c four c.____ d zero d.____ e eight e.____ f three f.____
• read number words up to 10	► Read the number on each card. seven ten four zero eight three
• explore, represent, and describe numbers up to 50 in a variety of ways	► Show the number 23 in different ways: - using different materials (e.g., blocks, beans, money) - using pictures or diagrams - using numbers 23
• use a calculator or computer to explore and represent numbers up to 100	► Experiment to see which buttons you have to push to show the number 13 on your calculator or computer screen; which for 23; which for 32. Try four more than three; three less than eight.
• demonstrate and explain orally an understanding of "half" as part of a whole	► Imagine that you want to share an apple equally with a friend. How much of the apple do each of you get?

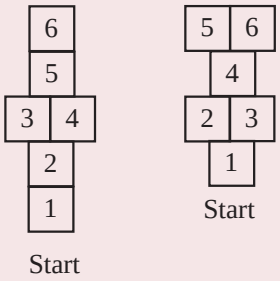
NUMBER *(Number Operations)*

Students demonstrate an understanding of and a proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• demonstrate and orally describe the process of addition and subtraction of whole numbers to 18 using role-play, manipulatives, and diagrams (memorization is not intended)	► Draw simple pictures to show the action for adding and subtracting. - Show 6 things. Add 3 more. How many are there? - Show 8 things. Take away 5. How many are left?

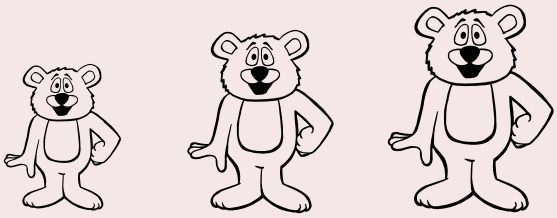
PATTERNS AND RELATIONS *(Patterns)*

Students use patterns to describe the world around them and to solve problems.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• identify, reproduce, extend, create, and compare patterns using actions, manipulatives, diagrams, and spoken terms	► Look at the two hopscotch patterns taped out on the floor. Compare the patterns.  Hop out the pattern (one foot down, two feet down). What square(s) and what number would come next in each pattern? Make up your own hopscotch pattern.
• recognize patterns in the environment	► Look around the room. Describe one pattern you see. What counters, pictures, or words might you use to copy the pattern you see? Choose one, then show your pattern on paper.

SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• classify, describe, and arrange objects using comparative language to compare length, size, area, weight, and volume	► Which teddy bear is tallest? Which bear is shortest? Put the three bears in order from shortest to tallest. 
• use comparative terms to describe time and temperature	► Is it warmer today than yesterday? How can you tell?
• compare the relative sizes of non-standard units by measuring the same object using different units of measurement, and recognize that different objects may have the same mass	► Measure the width of the chalkboard using the wide part of your thumb as the unit of length. Measure the chalkboard again, but this time use the length of your pencil as the unit of measure. How does the number you got in each measurement compare to the size of the unit you used for measuring?
• select an appropriate non-standard unit to estimate, measure, record, compare, and order objects and containers	► Find the volume of two different containers by using one of the following instruments: eye dropper, ruler, soup can, teaspoon, tablespoon, or drinking cup. Explain your choice of instrument. Record your measurements and tell which of the two containers has the greater volume.
• estimate the number of uniform objects and irregular shapes that will cover a given area and verify their estimates by covering and counting	► Estimate the number of pairs of your shoes that could fit on the boot rack. Try fitting them on the rack. What did you discover? Did it matter how you arranged them? Tell what you found out.
• compare and sequence events according to the duration of time (using non-standard units), time of day, days of the week, and the seasons	► Use clothespegs to hang up school activity cards in the order the activities will occur today. Is morning recess longer or shorter than a TV program? Is recess longer or shorter than a song?

SHAPE AND SPACE (*Measurement*)

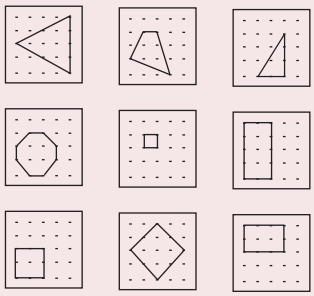
Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• recognize and name the value of pennies, nickels, and dimes	► Sort a collection of pennies, nickels, and dimes according to their value. Name the types of coins found in each set. What is the value of each type of coin?
• use money as a form of exchange	► Imagine that you are in a store and you see some stickers that you like. Find out how much the stickers cost. Do you have enough pennies to buy one sticker? How do you know?
• create equivalent sets of coins up to 10¢ in value	► Construct a set of coins equal in value to 10¢. Build a different set also equal in value to 10¢.

Value	Dimes	Nickels	Pennies
Set 1			
Set 2			
Set 3			

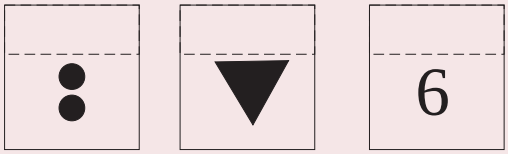
SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• explore and describe real-world and three-dimensional objects using descriptive attributes such as *big*, *little*, *like a box*, and *like a can*	► Reach into a bag filled with different objects and see if you can find the can or cylinder. How did you know you had found the can or cylinder? Reach in and hold another object. Describe your object.
• explore, identify, and classify three-dimensional objects in the environment according to their properties	► Sort and classify a selection of objects (e.g., cans, cones, balls, glasses). Explain your classification. Experiment to discover which objects will roll.
• construct three-dimensional objects using materials such as plasticine, blocks, and boxes	► Choose a 3-D object. What is your object called? Make a model of it, using modelling clay, play dough, or blocks.
• identify and describe specific two-dimensional shapes such as circles, squares, triangles, or rectangles	► Sort this collection of geodot shapes into two groups. Name each group.  Find another way to sort the drawings. Identify each shape as a circle, triangle, rectangle, or other.
• construct and rearrange a design using a set of two-dimensional shapes	► Here is a design made of squares. Does it match the clap, slap pattern? Use more squares to continue the pattern to the edge of the desk. What is another way to describe the design? R G R G R G
• compare, sort, classify, and pattern two-dimensional shapes	► Take a scoop full of blocks: - sort out the red ones - push the blocks back together, then sort out the blocks that are triangles - make up your own sorting rule, then sort the blocks by your rule - make a pattern using the blocks

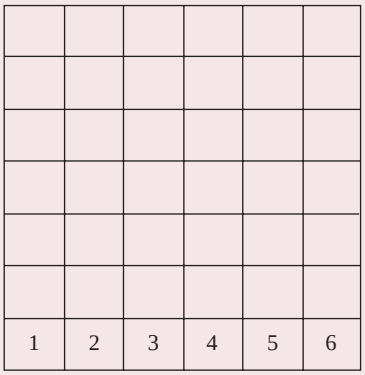
SHAPE AND SPACE (*Transformations*)

Students perform, analyse, and create transformations.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• use directional terms such as *over*, *under*, *beside*, *near*, *far*, *left*, and *right* to describe the relative position of objects and shapes	► Simon says: - put the longest pencil between the pen and the ruler - stand outside our circle, but beside my desk - walk between the outlines of the square and the triangle - place the book under the chair and set the box inside the circle
• match the size and shape of figures by superimposing one on top of another	► Use a set of tangrams to find two pieces with the same shape that match in size. What shape have you used? How do you know they are the same size? What other pieces have the same size?
• identify and fit pieces of puzzles or shapes that go together (part to whole relationship)	► Construct a large-piece puzzle. Tell how the pieces fit together to make the puzzle complete.
• explore and describe reflection in mirrors	► What do you think you will see in the mirror if you place it on the dotted line? Place the mirror on the dotted line and compare what you see with what you predicted. 

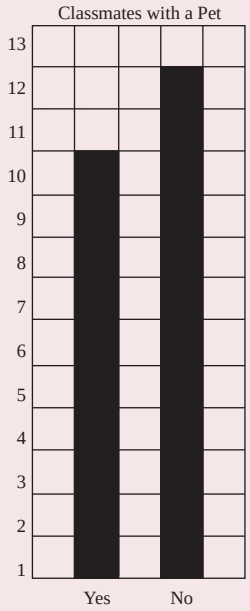
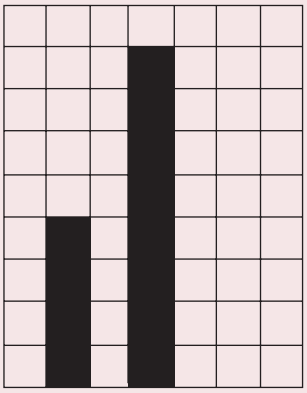
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• collect first-hand information by counting objects, conducting surveys, measuring, and performing simple experiments	► Which flavour of ice cream do your classmates like best? To find out if they prefer vanilla, chocolate, or some other flavour, survey each of your classmates and record each answer on the class list.  Use blocks on the graphing mat to show what you learned. What are three things your graph shows about ice cream flavours? Make up a question you might ask a friend about your graph.
• sort objects by one attribute chosen by themselves or the teacher	► Here is a collection of pattern blocks, two of each shape and colour. What is one rule you might use to sort the blocks into exactly two groups? Sort the blocks by your rule. How many blocks fit your rule? Without looking, tell how many blocks do not fit your rule. How do you know? Make a new rule for sorting the blocks and sort them by your new rule. How many blocks fit your rule? How many do not?
• construct a pictograph using one-to-one correspondence	► Make a pictograph to show how many like swimming and how many don't like it. 

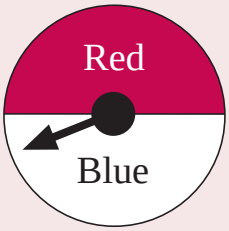
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• compare data using appropriate language, including quantitative terms	► This is Marco's graph. He wanted to know how many of his classmates have a dog for a pet. How many children did he survey? What did he learn? 
• pose oral questions in relation to the data gathered	► What do you think this graph is meant to show? What needs to be written down before everyone can understand the graph? What is a question you might ask a classmate about this graph? Can you think of another question to ask? 

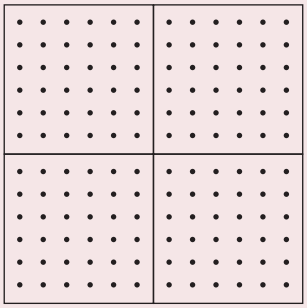
STATISTICS AND PROBABILITY (*Chance and Uncertainty*)

Students use experimental or theoretical probability to represent and solve problems involving uncertainty.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• predict the chance of an event happening using the terms *never*, *sometimes*, and *always*	► Using the words *never*, *sometimes*, and *always* tell how often the spinner will: - stop on blue - stop on green - stop on red or blue 

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• estimate and then count an increased number of objects in a set, and compare the estimate with the actual number	► Estimate the number of dots in the diagram. How did you get your estimate? What strategy did you use? Count the dots. Was your estimate close? Try to think of additional estimation strategies. 
• skip count forward and backward by 2s, 5s, 10s, 25s, and 100s to 1000, using starting points that are multiples; and skip count forward, using random starting points	► Travis has 1 five-dollar bill and 11 quarters. He starts at 500 and skip counts by 25s to find the total value of his money. What numbers does he say as he counts? What is his total? Mark programmed the calculator to skip count backwards from 125 by 5s. Predict the first 10 numbers he will see in the display. Will he ever see 0 in the display? Explain.
• recognize, build, compare, and order sets that contain 0 to 1000 elements	► Use base-ten blocks. Find several ways to show the number 257. With pictures, record each way you find. Complete the table for each way you find. Discuss how to build the number using the fewest number of pieces. H T O _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• round numbers to nearest 10 and 100	► Read the chart. On the last line, fill in your name and record your height in Unifix cubes. Round each height to the nearest 10 cubes.
• read and write number words to 100 and numerals to 1000	► Here is a list of the top speeds at which some animals can move over short distances. Dolphin: fifty kilometres per hour Elephant: 42 km per hour Dragonfly: fifty-nine kilometres per hour Human: 46 km per hour Wild turkey: ninety-two kilometres per hour Rewrite each, changing numerals into number words, and number words into numerals. Which animals can move at a rate of about forty kilometres per hour over short distances? About fifty kilometres per hour? Name three animals you think you can outrun.
• use ordinal numbers to 100	► Which is greatest: the 40th even number, the 10th even number that ends in 6, or the 20th number with at least one 2 in it? Explain your decision.
• explore, represent, and describe numbers to 1000 in a variety of ways, including the use of calculators and computers	► One way to make 90 is 45 + 45. Make 90 four other ways.

Name	Height in Unifix Cubes	Height to Nearest Ten
Dan	64	
Salhee	65	
Dawn	56	

Number (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• demonstrate place-value concepts concretely and pictorially to give meaning to numbers 0 to 1000	► Brenda is building numbers, using five pieces from a base-ten set other than the large cube. Her results are recorded in the chart below. Has she found all the possible numbers?

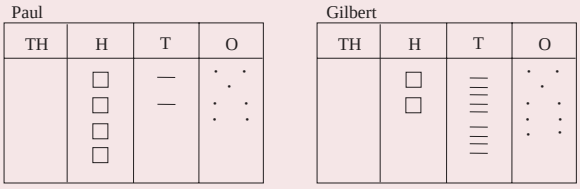
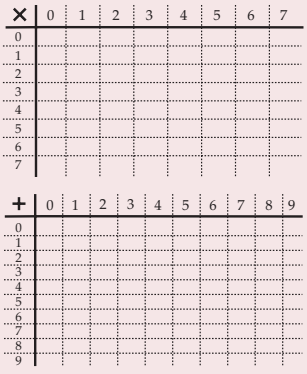
H	T	O	Number
	5		50
		5	5
	3	2	32
	1	4	14

Show how you would use any five pieces to make all possible numbers. Record your results. List the numbers from greatest to least.

Prescribed Learning Outcomes	Illustrative Examples
• demonstrate whether a number is even or odd	► To help her younger brother picture odds and evens, Danetta builds two-row rectangles using square tiles. Use Danetta's method with exactly 10 tiles. Is 10 an even or an odd number? Now use 11 tiles. Is 11 an even or an odd number? Name three odd numbers greater than 30, but less than 40. Explain how you know your numbers are odd.
• recognize and explain whether a number is divisible by 2, 5, or 10	► Briana used a hundred chart to show which numbers can be divided into equal parts. Use a hundred chart to show numbers that can be divided into: - 10 equal parts - 5 equal parts - 2 equal parts but not 5 equal parts - 2, 5, and 10 equal parts
• demonstrate and explain in a variety of ways an understanding of halves, thirds, fourths, fifths, and tenths as part of a region or a set	► Look at the name below. JASON BLACKBERRY Working with just the first name, explain the fraction of the letters that are vowels. Use grid paper to outline a rectangle that can be used to show the fraction of letters that are not vowels. Name the fraction and colour in green the part of the grid that shows the fraction. Repeat the activities for the last name. Repeat for all the names of people in your class. Do most names have a greater fraction of consonants than vowels? Report the findings of your investigation in your journal.

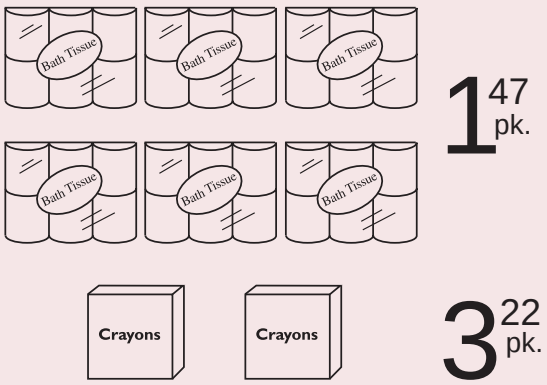
NUMBER (*Number Operations*)

Students demonstrate an understanding of and a proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• demonstrate and describe the processes of addition and subtraction of whole numbers up to 1000 with and without regrouping, using manipulatives, diagrams, and symbols	► Paul and Gilbert are using a pair of dice and base-ten blocks to play "Race to 1000." The gameboards show their total score, represented by blocks. What is each boy's score in numbers?  Each time they have a turn, the boys must show the new total, using the fewest blocks possible. On their next turn Paul rolls four 10s (1st die) and six 1s (2nd die). Gilbert rolls six 10s and three 1s. How will the gameboard look now? Write each boy's score in numbers.
• explore and demonstrate the processes of multiplication and division up to 50, using manipulatives, diagrams, and symbols	► Mom bought three packages of muffins. Each package held one dozen muffins. She repackaged the muffins before freezing them. Each freezer bag held three muffins. How many freezer bags did Mom use? Act out this story problem with counters. Write a number sentence to match this story. Make up your own two-step problem. Draw a picture to show the story and its solution.
• recall addition and subtraction facts up to 18 and multiplication facts up to 25	► Use the following grids to do addition and multiplication. 

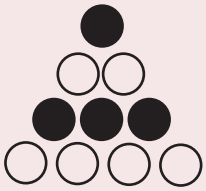
NUMBER (*Number Operations*)

Students demonstrate an understanding of and a proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• calculate and justify the methods they used to find sums, differences, products, and quotients using estimation strategies, mental math techniques, manipulatives, algorithms, and calculators	► If you bought all the items pictured below, how much would it cost you? Estimate the answer. Arnie and Cindy estimated the cost as follows: Arnie 2 x $3 = $6 6 x $1 = $6 $12 Cindy 2 x $3 = $6 2 x $1.50 = $3 2 x $1.50 = $3 2 x $1.50 = $3 $15 Explain each one's strategy. Which strategy would you use? Why? Use a calculator to find the exact cost. Which estimation strategies produced a closer solution? Why? 
• verify their solutions to problems by using inverse operations, estimation, and calculators	► Amy says she corrects her own calculations by adding to check her subtraction and subtracting to check her addition. She says 264 added to 727 is 991, and 369 subtracted from 806 is 447. Use Amy's strategy to check her work. Do you think Amy's arithmetic is correct? Explain. Redo any arithmetic that is incorrect.

PATTERNS AND RELATIONS (*Patterns*)

Students use patterns to describe the world around them and to solve problems.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• identify, create, and describe number and non-number patterns	► Colour the multiples of 2 on a hundred chart. Describe any patterns you see in your colouring. If you coloured the multiples of 5 on another hundred chart, how would your charts look alike? How would they look different?
• translate patterns from one mode to another using manipulatives, diagrams, charts, calculators, spoken and written terms, and symbols	► Create a growing or repeating pattern. Describe your pattern in oral or written form. Give your description to a classmate. Ask your classmate to reproduce your pattern. Compare your patterns. Were they alike? Was your description clearly understood?
• explain the rule for a pattern and make predictions based on patterns using models and objects	► Dana is using two colours of counters to build a pattern that "grows and grows."  What is the name of the shape Dana is making? What can Dana do next to continue the pattern? Build on Dana's pattern and continue it for three more rows. Name the number of counters in each dark-coloured row. What is the same about these numbers? What other patterns can you see in this arrangement?

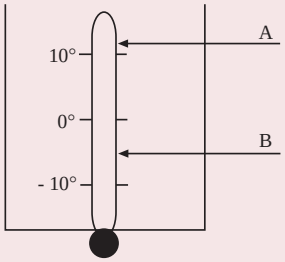
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• estimate, measure, record, compare, and order objects and containers using non-standard and standard units	► Which is longest: the distance around the top edge of the wastebasket, the perimeter of a chair seat, or the length of the teacher's desk? Predict the measurement of each. Use a measuring tape to check your estimates. Were your estimates close?
• construct a shape, length, or object using a specific non-standard unit or standard unit	► You have two congruent squares that have an area of one unit. Together they make up a total area of two square units. Fold one square on the diagonal. Cut on the fold line. Describe the two new pieces. Use all three pieces to make some different (non-congruent) shapes, each with an area of two square units. If only edges of the same length are placed together, how many different shapes can you make, each with an area of two square units?
• select the most appropriate standard unit for measuring length (cm, m, km), mass (g, kg), volume (L), and time (minutes, hours, days)	► Olenka needs to measure the length of her classroom. She has a measuring tape that is only 150 cm long and divided into millimetres, centimetres, decimetres, and metres. Which one of these units should she use? Explain your reason. Use a tape to measure the length of your classroom.
• describe relationships among various standard units of measure	► Describe the relationships among cm, dm, and m.
• relate the size of units to the number of units needed when measuring	► Cut a piece of string so that it is the length of your arm. Use this string to measure the length of your classroom. Repeat this measurement using another string that has been cut to the length of your thumb. Compare the number of each measurement. Is there a connection between the size of the measure and the size of the unit you used to measure it?
• recognize that the size and shape of an object does not necessarily determine its mass	► Can something that is small be heavier than something that is large? Find two objects to experiment with, then use a balance scale to prove your thinking.

SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• make connections among manipulatives, diagrams, spoken terms, and written symbols	► Transpose patterns from one medium to another: - concrete to concrete (Unifix to toothpick) - concrete to pictorial (blocks to pictures) - letters to numbers (ABBA to 2442)
• estimate and measure the passage of time in terms of seconds, minutes, hours, days, weeks, months, and years and relate the various measures to each other	► Estimate the number of time units you need for each activity: - minutes needed to watch a favourite video - hours you sleep on a weekend Explain how to check each estimate. Jorge says it is three weeks and two days to his birthday. How many days is it until his birthday? Explain how you know. Mira is two and a half years old. How many months since she was born? Explain your thinking. The video is 90 minutes long. Is that more or less than an hour? Explain.
• read and write the date, including the days of the week, and use the abbreviations and names of the months of the year in order	► What is the date of each? - the third Sunday in August - the second Wednesday in April
• read and write time to the nearest minute using 12-hour notation (use both a digital and an analog clock)	► [No example for this prescribed learning outcome.]
• estimate, read, and record temperature to the nearest degree Celsius	► Study this thermometer and print the temperatures indicated by arrows A and B.  Research the high and low temperatures in your community last year. Draw a thermometer. Label and identify both the high and the low temperatures you discovered.

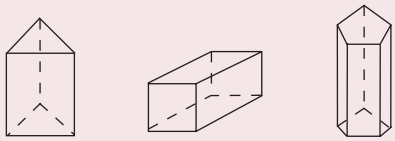
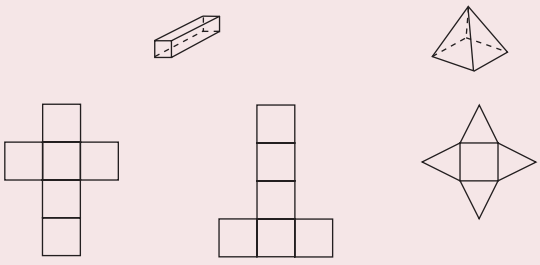
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• relate temperature to real-life situations	► Name a temperature that is about right for each: - viewing a movie at home - swimming in an outdoor pool - skating on an outdoor rink - calling the doctor, if you are running a fever
• identify and use coins and bills (to $100) to estimate, count, record collections, create equivalent sets, and make change up to $10	► Imagine stacks of coins equal in height to your pointer finger. Estimate the number of coins and the total value of each stack if it is made of pennies, of dimes, or of quarters. Build the stacks using real money. Count, then record the number of coins and the value of each stack. Compare with each of your estimates. How does the length of your pointer finger compare to the length of a five-dollar roll of dimes? Dad pays for a $3.49 present with a ten-dollar bill. Count back the change he should receive, beginning from $3.49. I have more than a dollar in coins in my pocket, but I can't make change for a dollar. Which coins do I have in my pocket? Look for multiple solutions.
• read and write both forms of money notation (e.g., 89¢ and $0.89)	► Ross had a dollar, and then he spent 17¢. Using numbers and symbols only, what are at least two ways to write the amount of money he has remaining?

SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• compare, contrast, sort, and classify two-dimensional shapes and three-dimensional objects using two or more attributes	► You are given several 3-D objects. Compare and group them using two attributes: the number of sides they have, and whether they can roll. Fill in the chart, showing the number in each group. | | Less Than 5 Sides | 5 Sides or More | |---|---|---| | Will Roll | | | | Won't Roll | | |
• identify, count, and describe the faces, vertices, edges, sides, and angles for polygons and solids	► Count the number of faces and vertices. Is there a pattern? Explain. 
• describe and name three-dimensional objects (cubes, spheres, cones, cylinders, pyramids, and prisms) and use appropriate two-dimensional names to describe their faces	► Choose an assortment of objects and draw, trace, or make prints of the faces. Identify and name the faces.
• describe and name pyramids and prisms by the shape of the base	► Identify the shape of the base, and name the prism or pyramid. Cut out each of the following nets. Fold each one to make an object. What object does each net make? Make a different net for the same object. 

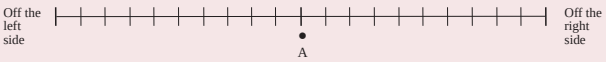
SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• construct skeletons of a three-dimensional object from a model and relate skeletons (nets) to models	► Examine a solid tetrahedron. Use toothpicks and modelling clay to make a skeleton of the shape. Break some of the joints to turn the skeleton into a 2-D net of the tetrahedron.
• demonstrate through dismantling that a rectangular solid has more than one net	► [No example for this prescribed learning outcome.]
• make identical, congruent two-dimensional shapes	► Draw two squares that are congruent. How do you know they are congruent?
• construct and rearrange a design using a set of two-dimensional shapes	► Cut apart shapes and try to reassemble them from the pieces, or use the pieces to create new shapes. Explain what clues you used to help decide how the shape should be reassembled.
• recognize congruent three-dimensional objects and two-dimensional shapes in the environment	► Identify shapes in your classroom that are congruent. Can you tell they are congruent?
• explore the concepts of points, lines, perpendicular lines, parallel lines, and intersecting lines on three-dimensional objects	► Choose an empty container to show: - parallel faces or lines - perpendicular faces or lines - intersecting faces or lines

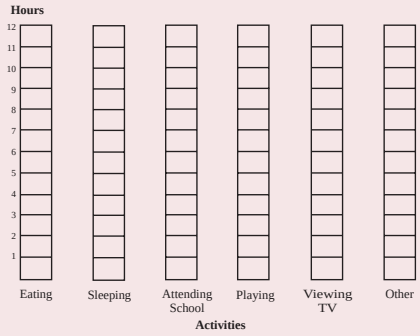
SHAPE AND SPACE (*Transformations*)

Students perform, analyse, and create transformations.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• communicate and apply positional language and cardinal directions (relating to compasses and maps) in verbal, written, or numerical form	► Let the front of the room be north. The student "turtle" always begins by facing north. Plan a program to move a student "turtle" from your desk to the classroom door, using directions and the number of steps. Test your program. Does it work?
• graph whole number points on a horizontal or a vertical number line	► What is the temperature in your classroom? Draw a vertical line marked with numbers to show the temperature. Make your number line show 10 more degrees and 10 fewer degrees than the room's temperature. Label your number line.
• trace a path on a line following oral or written instructions	► Take a trip along the line, starting at A.  You get six turns to see where your trip takes you along the line. Each roll of a die is a turn. If you roll an even number, take that many steps to the right. If you roll an odd number, take that many steps to the left. Keep track of where you are in the line at the end of six turns. Do this for 10 games. What patterns do you see? Tell when you are likely to go off the line.
• make congruent shapes and symmetrical two-dimensional shapes using folds and reflections	► Fold a rectangular piece of paper to make two congruent shapes. Are the shapes congruent?

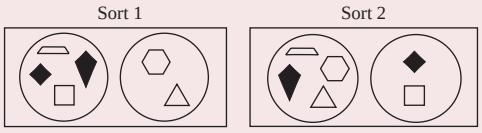
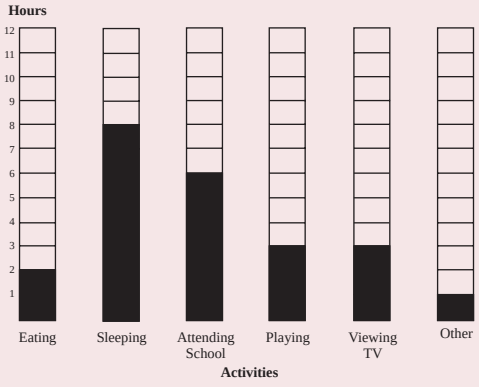
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• formulate questions and categories for data collection and actively collect first-hand information	► What is one thing you would like to learn about your classmates? Will you get your information by counting, by measuring, or by surveying? How do you plan to keep a record of the information you gather?
• use a variety of methods to collect and record data, including measuring devices, printed resources, and tallies	► Collect and record data about how much time you spend each day on a variety of activities. Colour a rectangle, or part of a rectangle, for each whole or part hour you spend on that activity.  What can you say about how you use your time? Aldo surveyed two Grade 3 classes to find their favourite movies or videos. This is his tally chart. Movie or/Video | Tally | Total 1st Favourite | 𝍸 𝍸 | 2nd Favourite | 𝍸 𝍸 𝍸 | 3rd Favourite | 𝍸 𝍸 | 4th Favourite | 𝍸 5th Favourite | 𝍸 |||| Complete the tally chart. How many children did Aldo survey? How many children voted for the second favourite? How many did not vote for the second favourite? How are the two answers related? Show the results of Aldo's survey on a bar graph, then make a pictograph to show Aldo's information. Let one picture represent two votes. Which display do you think best shows Aldo's information? Explain your answer. What five movies or videos do you suppose would be the favourites in your class? Predict the tally you would get, if you surveyed your class with your list of five favourite movies or videos. Explain your prediction.

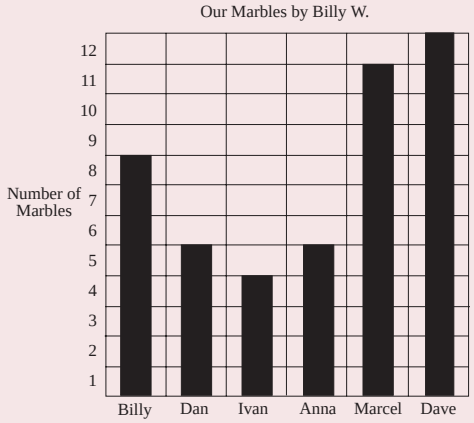
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• sort and organize data by one or more attributes and by using graphic organizers such as lists and charts	► The students in Room 10 conducted a mathematics experiment. Each person shook and spilled a pair of two-colour counters. They recorded how the counters landed, using R for red and Y for yellow. R,R R,Y R,Y R,Y Y,Y R,R R,Y Y,Y Y,Y R,R R,Y R,Y Y,Y R,Y R,Y Y,Y R,Y R,Y R,Y R,R R,R R,R Y,Y R,R Organize and make a chart to show the results of the class experiment.
• identify attributes and rules in pre-sorted sets	► Ron sorted pattern blocks, shown in the diagram Sort 1. Name Ron's sorting rule. He re-sorted the blocks, shown in Sort 2. What might be Ron's new sorting rule? 
• display data in more than one way, including graphs, pictographs, bar graphs, and rank ordering	► Order the activities in Ron's chart from the most to the least. Display your data in the new order. 

STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• discuss data, communicate conclusions, and make predictions and inferences to solve similar problems • generate new questions from displayed data	► Look at Billy's graph. - What do you think Billy wanted to learn about marbles? - Which student had the most marbles? the fewest marbles? - How many more marbles does Dave have than Billy? How do you know? - Who has more, Dave or Anna? How many more? - How many students did Billy survey? How many were girls? Do you think Billy should have asked more girls? - Will Billy's graph look the same if he gathers the information again tomorrow? Next week? 
• obtain new information by performing arithmetic operations on the data	► Five friends each recorded the total number of minutes they spent getting to and from school in one week. Here is what each one recorded: Ron 70 Dan 100 Juan 450 Beth 200 Dana 90 About how many minutes per day does each student spend getting to and from school? What might Juan say about the total time his four friends spent getting to and from school? What might be the reason?

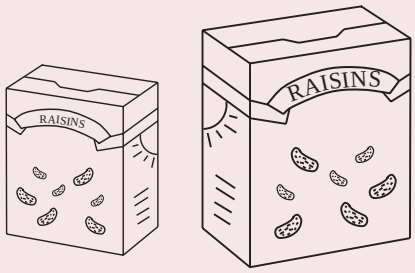
STATISTICS AND PROBABILITY (*Chance and Uncertainty*)

Students use experimental or theoretical probability to represent and solve problems involving uncertainty.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• describe the likeliness of an outcome using terms such as *likely*, *unlikely*, *fair chance*, *probable*, and *expected*	► Look at these words. likely unlikely expected or probable Choose one to help explain the chances of each of these statements happening: - It will snow today. - We will have recess tomorrow. - Your parents will give you a bike for your birthday. - You will see a movie at home this month. - When you shake and spill 4 two-colour counters, you will see only one colour. - When you roll a die, you will get a number greater than 1.
• conduct a probability experiment, choose an appropriate recording method, and draw conclusions and make predictions from the results	► How many ways can 2 two-colour counters land when they are spilled? Explain your answer with coloured drawings and compare your drawings with those of a classmate. If you spill the counters 10 different times, what colour combination would you expect to see most often? Why? Conduct an experiment to test your prediction. Keep a record of your results on each turn. Was your prediction correct? Repeat your experiment twice more. Carefully keep records of your results. What is your conclusion?

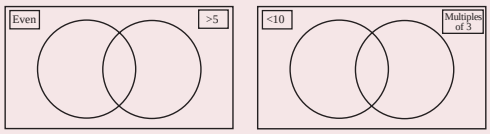
NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• estimate and then count the number of objects in a set (0 to 1000), and compare the estimate with the actual number	► Estimate the number of raisins in a 14 g snack box. Check by counting, and find the difference between your estimate and the count. Use this information to predict the number of raisins in a 42 g snack box. Check. Suppose you counted the number of raisins in a 450 g box. About how many raisins would you expect to find? Explain your reasoning. 
• use skip counting (both forward and backward) to support their understanding of pattern in multiplication and division	► Examine Roxie's method of solving problems. Dear Mom, I can do division questions by counting multiples. Example, 54 ÷ 9 = □. Skip count by 9 . . . 9, 18, 27, 36, 45, 54 ① ② ③ ④ ⑤ ⑥ Six skips of 9 is 54 so 54 ÷ 9 = 6. Love, Roxie. Use Roxie's method to solve these problems: 65 ÷ 7 = ____ 6 x 8 = ____
• compare and order numbers up to 10 000	► Use digit cards from 0 to 9. Pick any four cards. Make the smallest possible four-digit number. Make the largest possible four-digit number. Make three more four-digit numbers, and order them from smallest to largest.

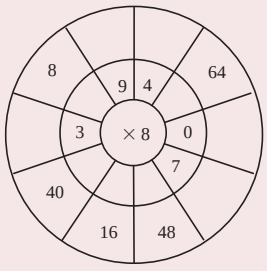
NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• read and write number words to 1000	► Use words to write the number that is: 150 less than 500 275 greater than 450 895 rounded to the nearest ten 895 rounded to the nearest hundred
• round numbers to nearest 10, 100, and 1000	► The coastline of B.C. is 7020 km long. Round to the nearest thousand kilometres.
• represent and describe numbers to 10 000 in a variety of ways	► 450 can be represented as 150 x 3. Represent 450 two more ways.
• demonstrate concretely, pictorially, and symbolically place-value concepts to give meaning to numbers up to 10 000	► Dale's teacher asked him to build a model of the number two thousand one hundred thirty-four. Dale has these base-ten blocks on his desk: two large cubes, two flats, twenty-five small cubes. Can Dale build the model? Use diagrams and numbers to explain your answer.
• sort numbers into categories using one or more attributes	► Write the numbers from 0 to 10 on separate pieces of paper. Place the numbered pieces of paper in the Venn diagrams according to the rules shown. When your work is complete, write each number on the diagram. 
• demonstrate an understanding of hundredths as part of a region or set • connect proper fractions to decimal fractions (tenths and hundredths) using manipulatives, diagrams, and symbols	► Let the base-ten flat represent one whole square. Use centimetre cubes to build a one-layer shape that is less than one whole square. Record your shape on centimetre grid paper. Write a fraction and a decimal to tell how much of the square is covered by your shape and how much of the square is not covered by your shape.

NUMBER (*Number Operations*)

Students demonstrate an understanding of and a proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• demonstrate and describe the process of addition and subtraction of numbers up to 10 000, using manipulatives, diagrams, and symbols	► Marnie is asked to show the number two thousand eight hundred fifteen. Show the number using base-ten blocks and a place-value chart. TH | H | T | Ones Next Marnie drew these three cards. 3 H | 9 Ones | 2 TH Show the number in the place-value chart. Describe how Marnie might use the blocks to show how she subtracts the two numbers. Draw a picture of her answer.
• demonstrate the process of multiplication (three-digit by one-digit numbers), using manipulatives, diagrams, and symbols	► Use a calculator to find two numbers whose product is 462. How many such numbers are there?
• demonstrate the process of division (two-digit by one-digit numbers), using manipulatives, diagrams, and symbols	► Make up a story problem to match this expression: 91 ÷ 7 Explain how you would estimate the quotient. Show how you would use base-ten blocks and numbers to calculate the quotient.
• recall multiplication and division facts up to 81	► Fill in the missing numbers. 

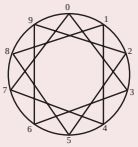
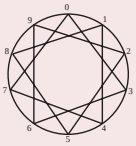
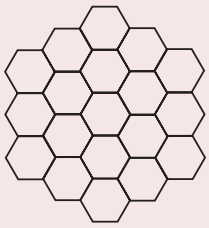
NUMBER (*Number Operations*)

Students demonstrate an understanding of and a proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• justify their choice of method for multiplication and division (using estimation, calculators, mental mathematics, manipulatives, and algorithms)	► Explain how to find the answers to the following questions faster by using mental mathematics strategies rather than by using a pencil-and-paper algorithm or the calculator. $3 \times 204 = ?$ $56 \div 9 = ?$
• verify solutions to multiplication and division problems by using estimation and calculators	► In each row, circle the pair of numbers you would use to best estimate the product. Explain your choice. $27 \times 16 =$ 30×20 20×30 30×10 $33 \times 24 =$ 40×20 30×20 30×30 Use a calculator to compare each estimate to the actual product. Did you make the best choice? Use your strategy to best estimate 28×36.
• verify solutions to multiplication and division problems by using the inverse operation	► Celine showed her division on the chalkboard. How would you use multiplication to check her quotient? $7\overline{)92}$ $\underline{35}$ 5 63 $\underline{35}$ 5 32 $\underline{28}$ 4 4 14 R 4 Do you agree with Celine's solution? If not, how would you correct it?
• demonstrate an understanding of the addition and subtraction of decimal fractions (tenths and hundredths) by using concrete and pictorial representations	► Show how you would use base-ten blocks to solve these problems: - Diana bought a magazine priced at $1.49 and a package of doughnuts priced at $2.18. What was the total cost, before taxes? - Sam had a roll of paper 4.2 m long. After he cut off a piece to make a banner, there were 2.5 m left on the roll. How long was the piece he cut off?

PATTERNS AND RELATIONS (*Patterns*)

Students use patterns to describe the world around them and to solve problems.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• identify and explain mathematical relationships and patterns through the use of grids, tables, charts, or calculators	► Janice investigated circle patterns to compare multiples of 3 and multiples of 7. Here is what she wrote in her journal: *I found the circle patterns for multiples of 3 and 7 are the same. That is because the digits in the 1s place are the same, but are located by moving in opposite directions around the circle.* Multiples of Three  Multiples of Seven  	0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	---
0	3	6	9	12	15	18	21	24	27	30 | | 0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	---
0	7	14	21	28	35	42	49	56	63	70	 Investigate circle patterns for other multiple facts. Find another pair of numbers whose multiples produce an identical circle design. Write a journal entry to explain your investigation.
• make and justify predictions, using numerical and non-numerical patterns	► Bees made a honeycomb. They started on day one with the middle cell. Each day they added another ring of cells all around the honeycomb. How many cells were there after the seventh day? What was the first day on which there were more than 1000 cells? 

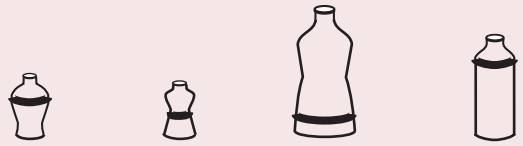
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• construct specific lengths (mm)	► Look at the line segment shown. Estimate if it is more or less than 100 mm long. Add to, or subtract from, the line segment to make it 100 mm long. Explain what helps you make your estimate. 
• select the most appropriate standard unit (mm, cm, m, km) to measure length • describe the relationships among mm, cm, m, and km	► Measure a variety of items in the room. Make a list and record the measurements without the unit of measure. Exchange papers with a friend who must complete the list by supplying the units. For example: - My pencil is 170 _____ long. - My book is 0.8 _____ thick. Prepare a second list, changing the unit of measure and leaving out the decimal point. For example, measure the pencil in millimetres. Then, write: "My pencil is 172 cm long." The friend must decide where to place the decimal point.
• estimate, measure, record, compare, and order objects by length, height, perimeter, and circumference using standard units (mm, cm, m, km)	► Choose five different empty cans. Include pop, soup, juice, and potato chip cans, if possible. Estimate each can's height and circumference in centimetres. Decide which will be greater: the can's height or its distance around. Record all your estimates, then measure the cans. - How close were your estimated lengths? - Were your predictions correct about height compared to circumference? Order the cans from largest to smallest for height and circumference.
• estimate, measure, record, compare, and order shapes by area using standard units (cm^2, m^2)	► Trace your hand, your shoe, a two- or five-dollar bill, a CD jacket, a telephone book cover, and a computer disk. Estimate the area of each in square centimetres. Order your estimates. Use a sheet of clear acetate centimetre grid or a measuring tape to determine the area of each object. Compare your estimates and your order to your measurements. Tell how successful you are at estimating area.

SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• construct a number of shapes given a specific area (cm^2)	► What are the dimensions of all the rectangles that can be constructed having an area of 24 cm^2? Use grid paper to record each rectangle.
• select the most appropriate standard unit to measure area	► Name two things whose area is best described in square centimetres and two things whose area is best described in square metres. Explain why.
• relate the number of units needed to the size of the units to measure the area of an object	► Murray says: "The larger the unit, the more of them you need to measure the area of a surface. So the smaller the unit, the fewer you need." Use drawings or examples to prove or disprove Murray's conclusion.
• estimate, measure, record, compare, and order the capacity of containers using standard units (mL, L)	► The following plastic containers have elastic bands placed at different heights: a 1 L drink bottle, a cooking oil bottle, a 2 L drink bottle, and a vinegar bottle. Estimate the number of millilitres needed to fill each container up to the elastic band. Order your estimates. Find containers like the ones shown and measure to check your predictions.  750 mL 600 mL 2 L 1 L
• relate the number of units needed to the size of the units to measure the mass of an object	► [No example for this prescribed learning outcome.]
• describe the relationship between grams and kilograms	► There are three objects. Their weights are: 1950 g, 2020 g, and 1590 g. Which object is closest to 2 kg? Explain your reasoning.
• solve problems involving mass using grams and kilograms	► Grade A large eggs weigh 56 g to 63 g each. An empty egg carton weighs about 50 g. Denny says he's holding about 3 kg of large eggs. Explain how to find the number of full cartons of eggs Denny must be holding.

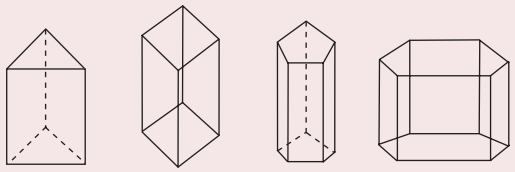
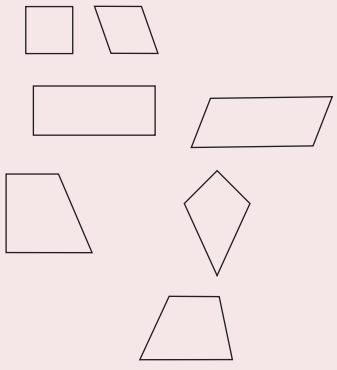
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• relate years, decades, centuries, and millenniums	► Jill's great-grandmother was born in the first decade of the 20th century. What might have been her year of birth? Explain. The year 2001 will begin the third millennium. Will you be living by the first year of the fourth millennium? Why or why not?
• read and write time on a 24-hour clock • read and write time using a.m. and p.m.	► Observe or research the following times. Record each time to the nearest five minutes, using numbers and symbols: - sunrise and sunset today - moonrise and moonset today - the arrival and departure of a boat, ferry, plane, bus, or train in your community
• estimate, count, and record collections of coins and bills up to $100	► Estimate the number of each kind of coin in a cup filled with pennies, nickels, dimes, quarters, and loonies. Count them, then record the total value. How would knowing the value of the coins in one cupful help you estimate the total value of a jar full of coins? A piggy bank full? Explain.
• make purchases and change up to $100	► Kenryu paid for an item with two twenty-dollar bills. His change was $8.32. What did the item cost? What coins and bills did Kenryu likely receive as change? Count back Kenryu's change, beginning with the cost of his purchase.

SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• design and construct nets for pyramids and prisms	► Troy found there are 12 different nets that fold to make a cube. He concluded that a 3-D object will have twice as many nets as it has faces. Choose one pyramid and one prism. Find as many nets as possible for each. Is Troy correct?
• relate nets to three-dimensional objects	► A net has five faces. What object might it produce when folded? Use drawings in your explanation.
• compare and contrast pyramids and prisms to describe a relationship	► Count the faces, vertices and edges for each of these prisms. Is there a pattern? 
• identify and sort specific quadrilaterals, such as squares, rectangles, parallelograms, and trapezoids	► Name each quadrilateral.  Sort the quadrilaterals using these rules: - parallel sides - all right angles - all parallel sides and a right angle - more than one pair of parallel sides and a right angle

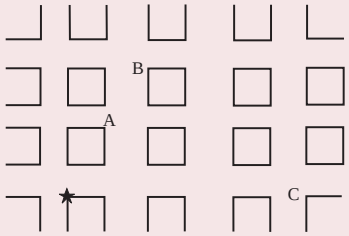
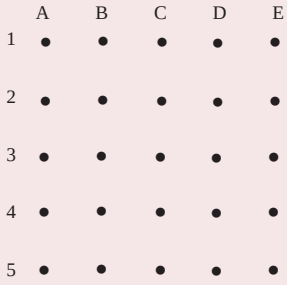
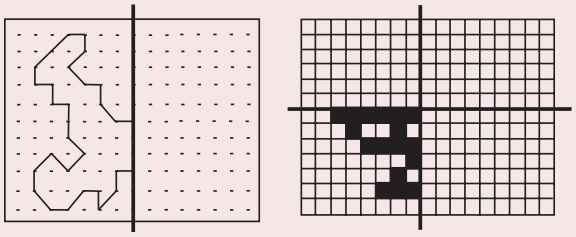
SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• classify angles in a variety of orientations according to whether they are right angle, less than a right angle, or greater than a right angle	► Demonstrate how to use a scrap of paper to create a right angle. Use your right angle to locate classroom objects with examples of the following angles: - an angle that is less than right - an angle that is greater than right - a right angle
• recognize, draw, and name the following: point, line, parallel lines, and intersecting lines	► Take a black and white picture from a magazine, newspaper, or colouring book. Do each of the following: - find a vertical line and colour it green - find a horizontal line and colour it blue - find two other lines that are perpendicular and colour them red - find two different lines that are parallel and colour them orange - find a point not already coloured and colour it purple - find two lines that intersect and colour them yellow

SHAPE AND SPACE (*Transformations*)

Students perform, analyse, and create transformations.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• communicate and apply terms of directions to maps (north, south, east, and west)	► On a simplified street map, locate special points of interest (e.g., store, school, mall, bridge) and label them A, B, C, and so on. Select a point of reference and mark it with a star. Describe the path from the star to B, using directions N, S, E, W. 
• place an object on a grid using columns and rows • describe the position of an object on a grid using columns and rows	► I am hiding at one of the points on the 5 x 5 geoboard. Use the numbers and letters to locate me in as few guesses as possible. 
• trace a path on a grid or map, using oral or written instructions (and vice versa)	► Write directions for going from your school to your home. Write directions to go from your home to your school. How are they the same? How are they different?
• create and verify symmetrical two-dimensional shapes by drawing lines of symmetry	► Complete each picture, using the lines of symmetry shown. 

STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples

It is expected that students will:

- select an appropriate sample or population and organize the collection of data
- manipulate data to create an interval graph or table for display purposes

How Tall Will I Be?

These activities allow you to complete information about your height expectations and answer questions about the heights of your family members. The table displays average heights for children. Family records might furnish data on a particular family. Other resources such as an encyclopedia, an almanac, or the *Guiness Book of World Records* can yield interesting related information. Have fun with these real-life mathematics activities.

AVERAGE HEIGHT FOR CHILDREN

Boys		Girls	
Age In Years	Height in cm	Age In Years	Height in cm
2	96.2	2	95.7
4	103.4	4	103.2
6	117.5	6	115.9
8	130.0	8	128.6
10	140.3	10	138.6
12	149.6	12	151.9
14	162.7	14	159.6
16	171.6	16	162.2
18	174.5	18	162.5

Source: *Current Pediatric Diagnosis and Treatment 1987*, edited by C. Henry, M.D., et al. Norwalk, CN: Appleton & Lang, 1987.

Predictions about Height

Use the table Average Height for Children to answer the following questions.

- Would you say that most members of your family are tall or short? Explain your answer.
- Ravi noted that he was 150 cm tall at age ten. Do you think he would be 300 cm tall at age twenty? Explain your response.
- Do you expect to be about average, taller than average, or shorter than average by age twenty? Explain your response.
- How likely are you to grow to be over 160 cm tall? Explain your answer.
- Make a bar graph comparing the heights of everyone living in your house. Order the heights according to the ages of the persons measured, beginning with the youngest.

Adapted from the *Arithmetic Teacher*, September 1991.

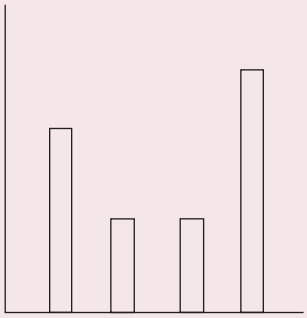
Vital Statistics

My height at birth: _____.
My height at age six: _____.
My age today is: _____.
I am _____cm tall.
I am _____cm taller than I was at age six.

I am taller/shorter than average (circle one)
I predict that my height will be _____ cm when I am fourteen.
I predict that my height will be _____ cm in ten years.

STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• construct a bar graph and a pictograph using many-to-one correspondence and justify the choice of intervals and correspondence used	► What might the following graph represent? Label the axes and show the scale(s) being used. 
• evaluate the process by which the data was collected	► Shinobu and her brother were arguing about whether Grade 4 students would rather watch hockey or figure skating on TV. Shinobu asked the first 20 students she saw in the morning. From the results, she decided about half the school would prefer watching hockey and half would prefer figure skating. Her brother Kelly asked 40 boys from Grade 4 and Grade 5. He concluded that all 200 students in the school would rather watch hockey on TV. Which person had the better plan for collecting reliable data? What would be a better way to collect this data?

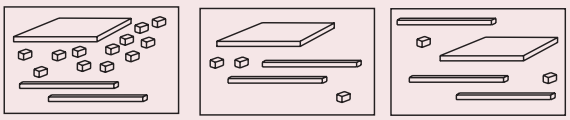
STATISTICS AND PROBABILITY (*Chance and Uncertainty*)

Students use experimental or theoretical probability to represent and solve problems involving uncertainty.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• identify an outcome using the terms *possible*, *impossible*, *certain*, or *uncertain*	► For each of the following, draw a spinner that matches the statement: - It is impossible to land on 5. - You are more likely to land on red than on green. - It is equally likely that the spinner will stop on red, yellow, blue, or white. - You are certain to spin an even number.
• compare outcomes using the terms *equally*, *likely*, *more likely*, or *less likely*	► Pull out a cube, record the colour, and replace the cube in the bag. Repeat a number of times. What is likely to come out next? - If we change the cubes to 5 red and 1 green, will the outcome be different? - What if we increased the number of cubes? - How have the outcomes changed? - What other things might affect the outcomes?
• design and conduct experiments to answer their own questions	► Chinus and Scott put tiles in a bag—4 yellow and 1 green. Chinus makes up a game. He says he gets 1 point for every yellow tile and Scott gets twice as many points for every green tile they pull from the bag. Do you think the game is fair? Play the game a number of times, stopping each game when one colour has earned 10 points. Was the game fair? If not, how would you change it to make it fair? Scott says the game would be better if there were 10 green and 40 yellow tiles in the bag. Would this change the game? Explain your answer.

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• demonstrate concretely and pictorially an understanding of place value from hundredths	► Here are pictures of three models made by students.  Monica Wade Salmo Which model(s) show 1.32? Explain. Janice did not use a 10 x 10 flat in her model of 1.32. Draw a picture of what she might have used for her model. Build another model of 1.32, using base-ten blocks.
• read and write numerals to a million	►Tony drew these five number cards. 1 3 0 2 3 Use all five of the cards to show the following: - the greatest possible number - the least possible number - three other possible numbers Write two of these numbers in words. Rewrite your numbers in order from least to greatest.
• read and write number words to 100 000	► Scan the newspaper to find six different numbers. Be sure at least one number is close to 100 000 and at least two numbers are less than 1. Also try to find numbers used different ways. Arrange your clippings in order, according to the size of the number involved. Rewrite numerals in words and vice versa. Show and explain how each number might be represented with blocks or fraction pieces.
• use estimation strategies for quantities up to 100 000	► Tell how you would determine if 100 000 grains of rice would fill a 1 L container. Tell how you would determine the number of classrooms needed for 100 000 people to stand comfortably.

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

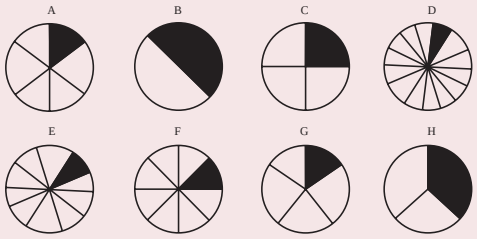
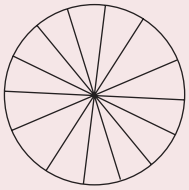
Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• recognize, model, and describe multiples, factors, composites, and primes	► Sort and record the numbers from 1 to 20, according to the rules listed in these Carrol diagrams.
• compare and order whole numbers	► Scan the newspaper to find six different numbers. Be sure at least one number is close to 100 000, and at least two numbers are less than 1. Also try to find numbers used different ways. - arrange your clippings in order, according to the size of the number involved - rewrite numerals in words and vice versa - show and explain how each number might be represented with blocks or fraction pieces

	Composite Number	Not a Composite Number
Even Numbers		
Odd Numbers		

	Prime Number	Not a Prime Number
Factor of 12		
Not a Factor of 12		

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

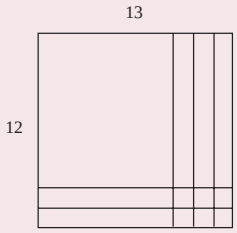
Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• represent and describe proper fractions concretely, pictorially, and symbolically • demonstrate and describe equivalent fractions	► Using this set of fraction pieces, identify and name the fraction or fractions that is or are: - closest to 0 - closer to a half than to 0 in size - the greatest fraction in your set - closer to 0 than to $\frac{1}{2}$ in size - close to, but not exactly, one half in size  Which of the fraction circles could be used to show $\frac{1}{2}$? What equivalent names match your choices? Give three other names equivalent to $\frac{1}{2}$. Identify fraction circles that show $\frac{2}{3}$. Name a fraction greater than $\frac{1}{2}$ but less than $\frac{2}{3}$. How could you use fraction circles to show your reasoning? 
• compare and order proper and decimal fractions to hundredths	► Put <, =, or > in the boxes to show how the numbers or expressions are related. $\frac{1}{4}$ ☐ 0.2 0.61 ☐ 0.16 0.75 ☐ $\frac{8}{10}$

NUMBER (*Number Operations*)

Students demonstrate an understanding of and a proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem, then solve the problem.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• add and subtract decimal fractions to hundredths concretely, pictorially, and symbolically	► You just got a gift of three goldfish from your grandmother and she gave you $20 to buy a bowl, a bowl ornament, and a supply of fish food. This chart shows the prices of these items at three different stores. Choose a possible selection of bowl, ornament, and food that you could buy with the $20. - What is the cost of your selection? - How much change would you receive? - How many different ways could you buy the three things and still spend $20 or less? Show each combination.
• estimate, mentally calculate, or compute and verify the product (three-digit by two-digit numbers) and quotient (three-digit by one-digit numbers) of the multiplication and division of whole numbers	► Greg and Nabat used base-ten blocks to build an array for 12 x 13. Greg and Nabat recorded their thinking differently. Explain the reasoning of each student. Build a model to explain 24 x 21.
• multiply and divide decimal fractions to hundredths concretely, pictorially, and symbolically using one-digit, whole number multipliers and divisors	► A total of $295.79 was collected by seven Grade 5 students for a field trip. What was the average amount collected by each student? Use play money to explain your answer.

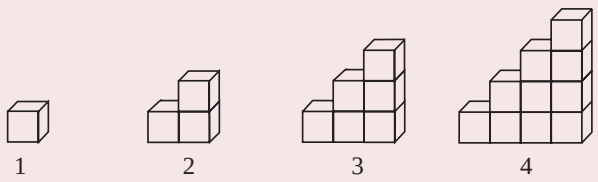
	Pet Zoo	Pampered Pets Shop	Johnson's Animals
Bowl	$7.00	$6.00	$8.00
Ornament	$8.50	$8.00	$4.75
Fish Food	$5.50	$4.50	$5.25



Greg	Nabat
12 x 13 = (10 x 13) + (2 x 13) 12 x 13 = 130 + 26 12 x 13 = 156	12 x 13 = (12 x 10) + (12 x 3) 12 x 13 = 120 + 36 12 x 13 = 156

PATTERNS AND RELATIONS (*Patterns*)

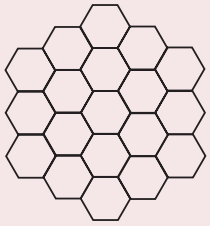
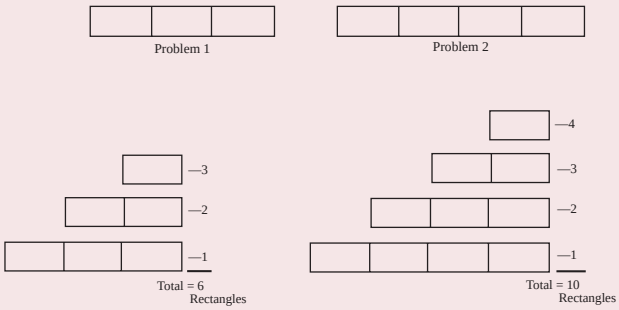
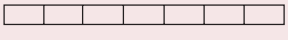
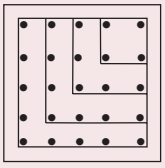
Students use patterns to describe the world around them and to solve problems.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• develop charts to record and reveal number patterns	► How many whole numbers less than 1000 have 12 as the sum of their digits? For example: 84□ 8 + 4 = 12 129 1 + 2 + 9 = 12 507 5 + 0 + 7 = 12 Carefully organize your investigation. Describe the patterns you see in the numbers.
• describe how a pattern grows using everyday language orally and in writing	► Darcy uses cubes to build these shapes.  1 2 3 4 Explain how the pattern grows.
• construct and expand patterns in two and three dimensions, concretely and pictorially	► Luis developed this chart to match a set of toothpick models. - Predict the next three numbers in the sequence. Explain your reasoning. - Predict the number of toothpicks needed to build the 25th shape and justify your answer. - Use the toothpicks to build the first three models in the sequence.

	1st	2nd	3rd	4th	5th	6th
Number of Toothpicks	6	11	16			

PATTERNS AND RELATIONS (*Patterns*)

Students use patterns to describe the world around them and to solve problems.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• generate number patterns within a problem-solving context	► Bees made a honeycomb. They started on day 1 with the middle cell. Each day they added another ring of cells all around the honeycomb. How many cells were there after the 7th day? What was the first day on which there were more than 1000 cells? 
• predict and justify pattern extensions	► Derek wrote the following in his journal: *I use patterns to help solve geometry problems like these: How many rectangles can you find in this figure?*  Do you agree with Derek's solutions? Why? How would you solve these problems? How many rectangles are there in this figure?  How many squares are there in this figure?  Write your own journal entry to explain how you solved these problems.

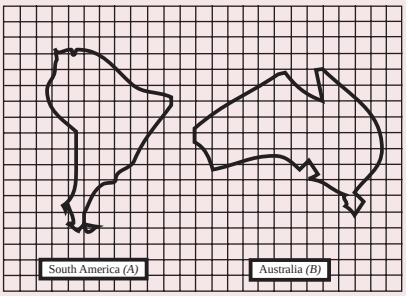
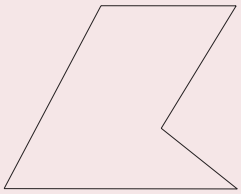
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• recognize and explain the meaning of length, width, height, depth, thickness, perimeter, and circumference	► Draw a 3-D outline of each shape: - soup can - cereal box - story book Find an object with: - a circumference of approximately 21 cm - a depth of approximately 10 cm - a perimeter of approximately 20 cm - a width of approximately 22 cm - a thickness of approximately 1 mm - a height of approximately 2 m - an area of approximately 600 cm^2
• solve problems involving mass using grams, kilograms, and tonnes	► Supermarkets order groceries in large lots. About how many packages are there in these lots? - 1 t of cookies packed in 400 g packages - 1 kg of spices packed in 5 g packages Explain your reasoning.
• evaluate which units of measure would be most appropriate when selecting different measuring tools	► Indicate the measuring tool and unit best used to measure: - the volume of air in your classroom - the capacity of a pill bottle - the mass of a train car full of wheat - the surface area of a kitchen table

SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• estimate and measure the area of irregular shapes by dividing them into parts	► Here are the outlines of two continents. - Estimate the area of each continent in squares. Explain your strategy. - Which continent has the greatest area? - Which continent likely has the longer perimeter? - Outline a shape with more area but about the same perimeter as Australia. - Estimate the area of one square in km^2. Explain your reasoning. 
• estimate and measure the perimeter of irregular shapes	► Determine the perimeter of this figure. 
• estimate and measure the effect on a rectangle's perimeter or area by changing one or more of its dimensions	► Monique used square tiles to construct a rectangle with a perimeter of 20 cm and an area of 21 cm^2. What are the dimensions of the rectangle? Use only whole numbers in centimetres for your answers. Monique decides to keep the perimeter at 20 cm. Predict what will happen to the area of her rectangle if she: - increases the length of her rectangle - decreases the length of her rectangle Outline and cut all possible rectangles with a perimeter of 20 cm. Check your predictions.

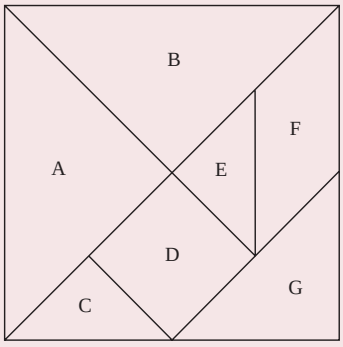
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• relate the perimeter and area of a rectangle, using manipulatives and diagrams	► Do you think a square and a rectangle with the same perimeter have the same area? Explain your reasoning. Draw pictures to help others visualize your thinking.
• relate the units cm^3 and mL	► How many mL of juice will fit inside a plastic container that has a volume of 705 cm^3? Explain.
• estimate, measure, record, and order containers by volume using cm^3	► Choose three different cracker boxes. Estimate the volume of each box in cubic centimeters. Order the boxes according to your estimate. Show how to use centicubes or a ruler to check your estimates. Were your predictions right? Explain your results.
• construct objects of a specific volume expressed in cm^3	► Use centicubes to construct cubes with lengths of 2 cm and 3 cm. Draw 3-D pictures of cubes 1 cm, 2 cm, and 3 cm in length. Fill in the chart to show the number of cubes needed for cubes 1 cm, 2 cm, 3 cm, and 4 cm in length. Then explain how to use a calculator to fill in the remaining numbers on the chart. Length of Edge (cm) of Constructed Cubes: 1, 2, 3, 4, , , , Number of centicubes used: , , , , , , ,
• read and write SI notation for recording date and time	► Use SI notation to write: - today's date - your birthday - when you will graduate from high school - a date that is special to you

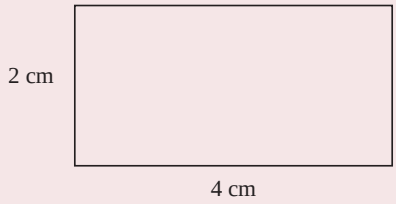
SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• construct, analyse, and classify triangles according to their side measurements	► Kylee had a supply of straws in three different lengths: 9 cm, 15 cm, and 20 cm. How many different triangles could she make? Use straws or pictures to explain your answer. Sort the triangles into sets with: no equal sides, two equal sides, and three equal sides. Name the sets.
• build, represent, and describe geometric objects and shapes	► Make a large class chart like the one below to show the shapes you can build with tangram pieces. Fill all the spaces. Pieces are traced, cut out, and posted as solutions are found. Three examples are given. Try to make each shape, using different numbers of tangram pieces. You may not find them all. Add in rows for 4, 5, and 6 pieces. | | Square | Rectangle | Triangle | Parallelogram | Trapezoid | | 1 piece |  | | | | | | 2 pieces |  | | | | | | 3 pieces |  | | | | | | 7 pieces | | | | | |
• classify and name polygons according to the number of their sides (3, 4, 5, 6, 8)	► [No example for this prescribed learning outcome.]
• cover two-dimensional shapes with a set of tangram pieces	► Look at the tangram puzzle shown.  Can you make a triangle with 2 tangram pieces? 3 pieces? 4 pieces? 5 pieces? 6 pieces? All 7 pieces? Draw and label pictures to show the triangles and the pieces used.

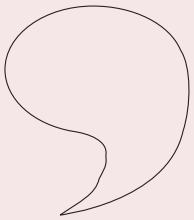
SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• complete the drawing of a three-dimensional object on grid paper given the front face	► Given the front face of a box that is 2 cm x 4 cm x 3 cm, draw the 3-D shape. 
• determine experimentally the minimum information needed to draw or identify a given two-dimensional shape	► What other information do you need to know so that you and a friend can draw the same triangle, if all you know is that one side is 2 cm and another is 3 cm?

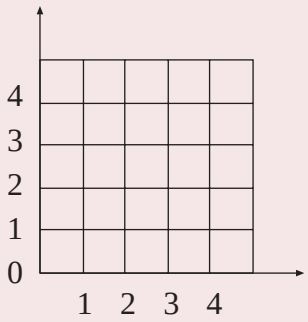
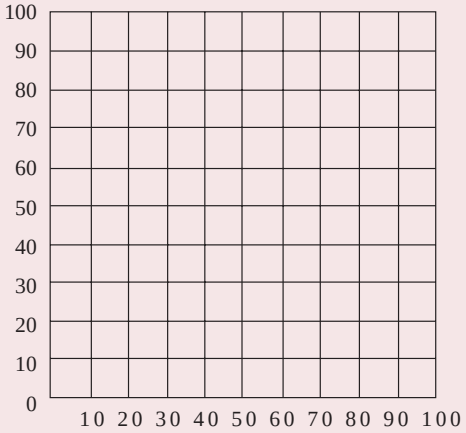
SHAPE AND SPACE (*Transformations*)

Students perform, analyse, and create transformations.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• recognize motion as a slide (translation), a turn (rotation), or a flip (reflection)	► Cut out the shape shown.  Use it as a tracer to create three different wallpaper designs. Use only slides to create one paper, only flips to create the second paper, and turns as well as slides to create the third paper. Which do you prefer? Explain.
• recognize tessellations created with regular and irregular shapes in the environment	► Look around your neighbourhood for some examples of tessellations created from tiling with regular shapes. Draw one. What is an example of an irregular shape? Give one instance of such a shape being used in a tessellation. Tell whether you prefer tessellations produced by using regular or irregular shapes. Why?
• locate planes of symmetry by cutting solids	► Construct 3-D solids out of modelling clay. Use piano wire to cut each solid along a plane that you think divides your solid into two congruent halves. Report your investigation in your mathematics journal. Tell how many planes of symmetry you found in each solid. Draw and label the shape of the symmetrical plane(s) found. Tell where you have seen similar planes in the human-made structures in your community.

SHAPE AND SPACE (*Transformations*)

Students perform, analyse, and create transformations.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• use coordinates to describe the position of objects in two dimensions • plot whole number, ordered number pairs in the first quadrant with intervals of 1, 2, 5, and 10	► Mark and label the two points A (1,2) and B (3,2) on this grid. Join the points with a straight line. - Mark another point C so that the triangle ABC is an isosceles triangle. Write down the coordinates of point C. - Mark point D so that ΔABD is a right triangle. Write the coordinates of D. - Mark point E so that ΔABE is a scalene triangle. Write the coordinates of E. 
• identify a point in the first quadrant using ordered pairs	► Plot the following points on the grid: A (10, 30); B (60, 20); C (80, 90).  Join the points to outline a shape. What different ways do you know to describe the shape?

SHAPE AND SPACE (*Transformations*)

Students perform, analyse, and create transformations.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• cover a surface using one or more tessellating shapes	► Use pattern blocks to create a tessellation that is at least 25 cm x 25 cm in area.
• create and identify tessellations using regular polygons	► Use a combination of regular pattern blocks to create a triangle similar to the green triangle. Design the block to have one line of symmetry. Create and colour a tessellation.
• identify regular polygons that can tessellate a plane	► Use tape to fasten two different regular pattern block pieces together. Will the new shape tessellate a surface? If so, did you use slides, turns, or flips? Try different pairs of blocks, then create and colour a tessellation with your favourite block combination.

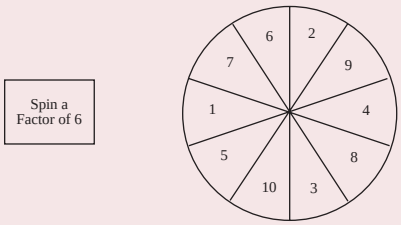
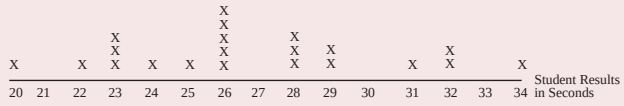
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• identify a question to generate appropriate data and predict results	► There are many different ways that potatoes can be prepared for eating. How would you word a question to find out about people's preferred kinds of prepared potatoes? What results do you predict? Describe a population and a sample that you could use to answer your question.
• distinguish between a total population and a sample	► For what kinds of questions could our class be considered as: - the total population? - a sample of a population?
• use a variety of methods to collect and record data	► A Grade 5 class learned that thousands of very large and very small potatoes are left in market gardeners' fields each fall. They decide to investigate only those potatoes that get picked and packaged for sale in grocery stores. What questions might they use to best guide their investigations? Predict what might be the answer to each question you designed above. Write out a plan for conducting the investigation. Include information on selecting a sample, collecting the data, recording the data, and displaying the data. Choose one of the questions you suggested for the Grade 5 class and conduct an investigation according to your plan. Write about the results of your investigation. What things have you learned about potatoes that get packaged for market?
• create classifications and ranges for grouping data	► Determine what groupings you would use to show changes in students' height throughout the school year (e.g., September to January, January to June). Determine the age groupings for the most listened-to music. Why did you choose to use the number of intervals you did (e.g., three groups as opposed to four groups)?

STATISTICS AND PROBABILITY (*Data Analysis*)

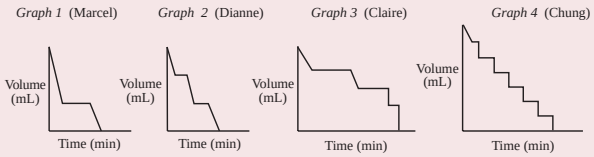
Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• display data by hand or by computer in a variety of ways, including: - frequency diagrams - line plots - broken-line graphs	► Wui-Ching needs to spin a 6, or any of its factors, to win the game he is playing. On a tally chart, record the data from at least 50 spins. Show all your data on a bar graph. Do you think Wui-Ching is more likely to win the game or to lose it? Why? 
• evaluate the graphic presentation of the data to ensure the clear representation of the results	► A class timed how long it took each person to count to 100 and represented the data in two different ways. - What is the same about each representation of the data? What is different? - Do you think one display better reveals the data than does the other? Why? - Choose another way to present the data. Label your work so others can read your graph quickly and easily. 

Time Intervals	Individual Results	Number of Students
20 - 24	20, 22, 23, 23, 23, 24	6
25 - 29	25, 26, 26, 26, 26, 26, 28, 28, 28, 29, 29	11
30 - 34	31, 32, 32, 34	4

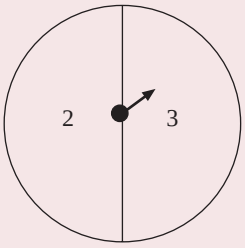
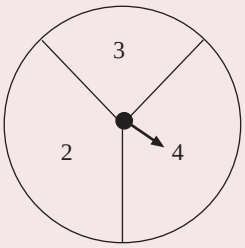
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• discuss the reasonableness of the data and the results	► Tina, Rex, and Liz are conducting reaction-time experiments with a metre stick. The goal is to catch the metre stick as quickly as possible after it is dropped. Each person has three chances to catch the metre stick. Here are the results. Distance Stick Dropped (cm) Trial Number | Tina | Rex | Liz 1 | 50 | 17 | 20 2 | 40 | 26 | 59 3 | 15 | 23 | 59 Explain who has the best reaction time if: - the lowest number of centimetres on any particular trial wins - the high and low distance for each person is eliminated - the average distance for each person is calculated (by adding the three results for each and dividing by 3) What method do you think is most fair for determining the best reaction time? Explain your reasoning. What number represents the mean reaction distance for all three friends? Make a bar graph to show and verify your calculation.
• make inferences from the data to generate a conclusion	► Four friends each bought a large cold drink on a hot summer day. Explain what each graph tells you about how each person drank.  Draw a graph to represent how you might drink a cold drink.

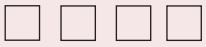
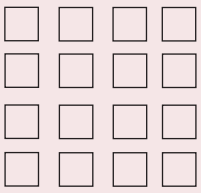
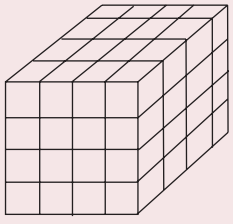
STATISTICS AND PROBABILITY (*Chance and Uncertainty*)

Students use experimental or theoretical probability to represent and solve problems involving uncertainty.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• list all possible outcomes of an event • explain events using the vocabulary of probability - *best/worst* - *probable/improbable* - *never/less likely/equally likely* - *likely/more likely/always*	► Use one or both spinners shown to make up a true statement. Use these words: - never - less likely - more likely - always Spinner A  Spinner B 
• conduct probability experiments and explain the results using the vocabulary of probability • conduct probability experiments to demonstrate that results are not influenced by factors such as the age, experience, or skill of the participant	► Yvon tossed 20 tacks. Of these, 13 tacks landed on their points. He uses the fraction $\frac{13}{20}$ to describe the probability of tossing "points."  Top  Point Yvon says he can now predict 39 "points" if he tosses 60 tacks. Explain his reasoning. Conduct an experiment to test Yvon's prediction. Compare your results with his prediction. Start a new experiment. Toss the tacks to establish the probability of landing "tops." Use your fraction to predict tossing "tops" and conduct an experiment to check your prediction. Compare your results with your expectations. If you continue to conduct experiments with tacks, will you improve your ability to toss exactly the number you predict? Why?

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• read and write numerals greater than a million	► The day after a telethon, the radio reports that about $2.1 million was raised. Explain why the value would be expressed in this way. What may have been the amount raised?
• use estimation strategies for quantities up to a million	► Estimate how many pages of your local telephone book are needed to list 10 000 names. Explain your estimation strategy. How can you check your prediction without counting 10 000 names? Carry out your plan and compare your prediction with your results. Use your work to predict the number of pages needed to list: - 100 000 names - 1 000 000 names
• distinguish relationships among multiples, factors, composites, and primes	► Use a Venn diagram to sort numbers from 1–25 that are: - prime - greater than 10
• represent positive powers of numbers concretely, pictorially, and symbolically	► Extend the pattern shown below to 4^4 and 4^5. $4 \times 1 = 4^1 = 4$  $4 \times 4 = 4^2 = 16$  $4 \times 4 \times 4 = 4^3 = 64$ 

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• use power, base, and exponent to represent repeated multiplication	► If the base-ten blocks represent the first four powers of 10, what will the first four powers of 2 look like? Use centicubes to construct 3-D models. Use your models to explain the shape and size of the fifth and sixth powers of 2. Sketch a diagram of the six models, labelling the dimensions, and write the total number of centicubes used in each. How will models representing the powers of 3 be like the models you have sketched? How will they be different?
• explain the meaning of *integers* by extending their counting to numbers less than 0	► A certain negative integer is: - less than -3 - greater than -7 - farther from -7 than -3 What is the integer? Draw and label a number line to justify your answer. Make up another set of clues about a negative integer.
• identify practical applications of integers	► Explain how negative numbers are used to help describe the following: - golf scores - temperatures - an example of your choice
• read and write numbers to thousandths	► Trevor's homework revealed this statement. 0.790 > 0.79 Is he correct? What model(s) or diagram(s) would you use to justify your answer? Order these numbers from least to greatest. 0.499□□□□□□2.66 $\frac{4}{3}$ $1\frac{7}{8}$ 0.1 Construct a number line to help Trevor visualize your thinking. Label each number.

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• demonstrate and explain the meaning of *improper fractions* and *mixed numbers* (positive) concretely and pictorially	► With the help of pattern blocks, and using the value of the yellow hexagon as one whole, make a pattern with a value of $2\frac{1}{2}$.
• demonstrate and describe equivalent mixed numbers and improper fractions concretely and pictorially	► Hexagonal work tables can be separated into half-tables that are trapezoidal in shape. James wants to make some hexagonal work tables. He has 13 half-tables. How many work tables can he make? Use pattern blocks to represent the trapezoidal and hexagonal tables and solve the problem. Draw a diagram of your solution. Use this model to explain how $\frac{13}{2}$ can be written as a mixed number.
• compare and order improper fractions, mixed numbers, and decimal fractions to thousandths	► Explain how you could order the following numbers from least to greatest, using a number line with the benchmarks of $\frac{1}{2}$ and 1. $\frac{3}{7}$, $1\frac{1}{3}$, $\frac{5}{9}$, $\frac{13}{12}$, $1\frac{4}{9}$

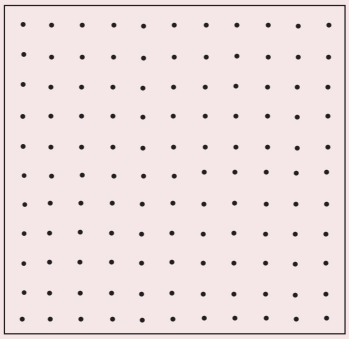
NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• demonstrate and explain the meaning of *ratio* concretely and pictorially	► Dennis linked 10 cubes together in this order: G G G G Y G G G G Y What colours are described by these ratios? 2:8 4:1 8:10 Suppose Dennis continued the pattern to cover a 10 x 10 grid. How would the ratios change? Use percent to describe: - the green area - the area not green - the red area Would it be true to write the following about the yellow area? $20\% = 0.20 = \frac{2}{10} = \frac{1}{5}$ Explain. Draw and colour a 5-cube train. Describe the colours in different mathematical ways.

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• demonstrate and explain the meaning of *percentage* concretely and pictorially	► Let the largest possible square on an 11 x 11 geoboard have a value of 1. Construct a different (non-congruent) shape for each part named below. 0.25 on the square $\frac{1}{4}$ of the square 25% of the square 

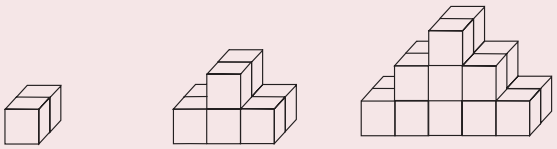
NUMBER (*Number Operations*)

Students demonstrate an understanding of and a proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• estimate the solutions to calculations involving whole numbers and decimal fractions	► On an average day in Canada, about 73 000 Canadians celebrate their birthdays. About how many people must there be in Canada? Estimate an answer. Use a calculator to find the answer.

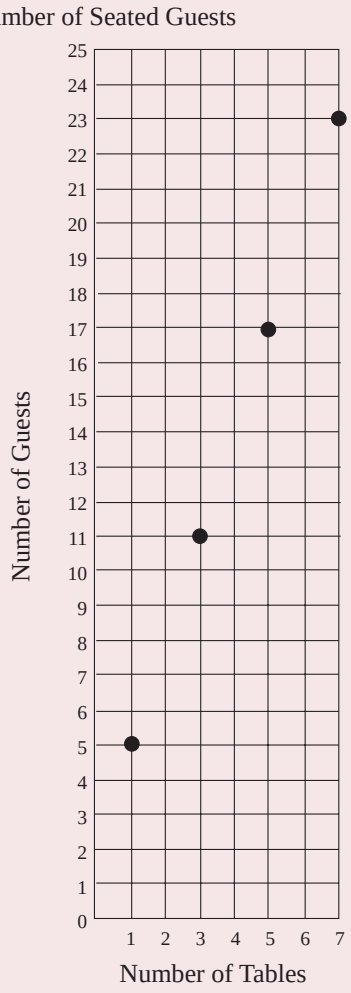
PATTERNS AND RELATIONS (*Patterns*)

Students use patterns to describe the world around them and to solve problems.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• construct a visual representation of a pattern to clarify relationships and to verify predictions • summarize a relationship using everyday language in spoken or in written form	► Greg used counters to build rectangles that expand in two directions. Then he produced this chart. Term | 1 | 2 | 3 | 4 | Number of Counters | 2 | 6 | 12 | 20 | Draw or use counters to construct the first four rectangles in Greg's pattern. Record your work on paper. Explain how the numbers in each column on the chart are related. Will 60 be a number that appears if the chart is extended? Explain why or why not.
• create expressions and rules to describe patterns and relationships (e.g., area, perimeter, volume)	► Provide a written description of how to build the fourth model in this series. Include a drawing.  1 2 3 Describe any patterns that can be seen in the models. Chart the number of cubes needed to build the first five models. Graph the relationship between the number of the model and the number of cubes needed to construct each. Use your graph to predict the number of cubes needed to build the 6th model.

PATTERNS AND RELATIONS (*Patterns*)

Students use patterns to describe the world around them and to solve problems.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• interpolate number values from a given graph • predict pattern relationships	► Joanne's graph plots the number of guests who can be seated at 1, 3, 5, and 7 tables. Explain how to use her graph to determine the number of people who can be seated if the number of tables is even, but less than 8. How might you determine the number of guests who can be seated at 10 tables? 

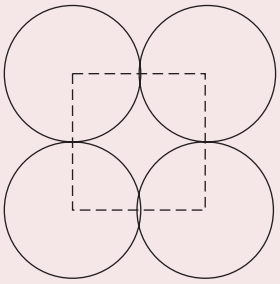
PATTERNS AND RELATIONS (*Variables and Equations*)

Students represent algebraic expressions in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• generalize a pattern by substituting numbers into a frame and compare the results to the original pattern	► Gretta sees that the number of lines increases by two for each triangle that is added. She predicts that the number of lines used is two times the number of triangles used. Do you agree with Gretta? Why?  Use a grid to plot the number of pairs in the pattern. Then use this graph to justify your answer. No.of Triangles / No. of Lines 1 / 3 2 / 5 3 / 7 4 / 9
• demonstrate the meaning and the preservation of equality using objects, models, and diagrams	► Lydia has 144 squares of fudge. She wants to design a box to hold the fudge. Suggest how she might design a box with the smallest possible perimeter.
• graph ordered pairs in the first quadrant, analyse results, and generalize relationships	► [No example for this prescribed learning outcome.]
• solve one-variable equations with whole number coefficients and solutions using informal techniques	► Fill in the missing number(s) in each equation. Choose two equations and explain how you know your answer is correct. $7 + \Delta = 9 + 4$ $16 - 7 = 3 + \Delta$ $\Delta \times 6 = 60 \div 2$ $2 \times (3 + 5) = \Delta - 4$ $\Delta + (3 \times 6) = \Delta + \Delta + 15$ There is a total of 11 red and yellow cubes in a bag. There are 3 more yellow cubes than red cubes. How many of each colour is in the bag?

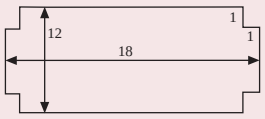
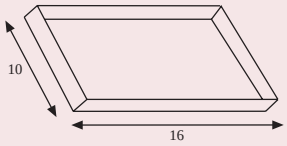
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• convert between commonly used SI units of length, mass, and capacity	► What is the difference between the highest and lowest of these prices? Explain how you know. Alaskan pollock fillets 69¢/100 g Pacific sole $3.90/kg Manitoba whitefish $0.32/100 g Fresh oysters $3.99/500 g
• develop, verify, and use rules or expressions to determine the perimeter of polygons	► Domenico has forgotten to measure one dimension of a room. What is the missing dimension? Three students each began to solve the problem, where P is the *perimeter*, L is the *length*, and W is the *width*. Domenico wrote: $P = L + W + L + W$ $46 = 16 + W + 16 + W$ Jake wrote: $P = (2 \times L) + (2 \times W)$ $46 = (2 \times 16) + (2 \times W)$ Owen wrote: $P = 2(L + W)$ $46 = 2(16 + W)$ Choose one boy's work and finish solving the problem. What is the missing dimension? Explain why you chose the work you did.
• develop, verify, and use rules or expressions to determine the area of rectangles	► Four loonies are arranged as shown.  The centres of the loonies are the vertices of a square. If the radius of a loonie is 13 mm, what is the area of the square?

SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• estimate, measure, and then calculate the surface area of right rectangular prisms (without using a formula)	► Carefully examine a drink box. Then estimate: - the surface area of the box in square centimetres - the volume of the box in cubic centimetres Measure the three dimensions. Explain how to use the dimensions to estimate: - the area of a grid paper jacket for the drink box - the volume of the drink box Use centicubes to explain how to calculate the volume of the drink box. Design a centimetre grid paper jacket to cover the box, then use the jacket to explain how to find the surface area of a rectangular prism.
• discover, generalize, and use rules to determine the volume of right rectangular prisms	► A manufacturer of open boxes has a large supply of cardboard sheets, 12 units by 18 units in length. The box-making machine can be set to cut square corners from each sheet before folding it to make an open box.   What is the volume of the box, if a 1 x 1 unit square is cut from each corner? Use centimetre paper to build a box with a 2-unit square cut from each corner. What is the volume of this box? Calculate the volume of all possible open boxes that the manufacturer could make. What size should be cut from the cardboard sheets if the open box is to have the greatest possible volume? Complete the chart to justify your answer. Size of Square Cut Outs | Length of Box | Width of Box | Volume of Box

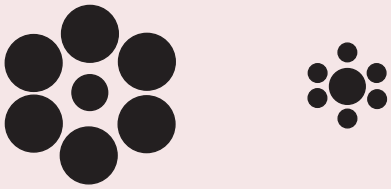
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• determine the volume of an object by measuring the amount of liquid displaced by that object (cm^3 or mL)	► Bring a stone to class and determine its volume.
• recognize angles as being more than 90°, equal to 90°, less than 90°, or greater than 180° • estimate and measure angles using a circular protractor • draw and sketch an angle in which the degrees in the angle are specified • classify given angles as acute, right, obtuse, straight, or reflex	► Use pattern block pieces to name the type of interior angle present in all blocks in the following sets. Set 1—hexagon, trapezoid, blue and tan rhombuses Set 2—triangle, trapezoid, blue and tan rhombuses Combine pattern block pieces to form new angles: - combine 2 blocks to form an acute angle - choose 1 block with an obtuse angle - combine 3 blocks to form a right triangle - combine 5 blocks to form a straight angle Trace and label an example for each. Demonstrate how to use a circular protractor to measure and name the angle in each example traced above.
• identify and compare examples of angles in the environment	► Look at or research business signs, logos, flags, and so on. How common is it to see triangles in these creations? Name the angles in the triangles you have noted. Continue the search by observing art work and crafts. How are triangles used in quilting? Wallpaper designs? Stained glass windows? Use triangles to create a work of your own. Then present your work, describing what triangles you used.

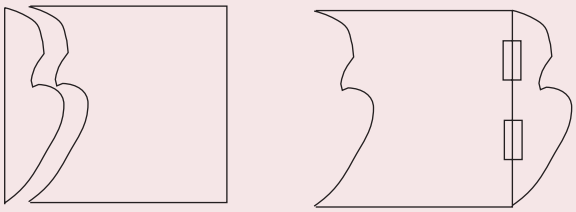
SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• classify triangles according to the measurement of their angles	► Create as many different triangles as possible on a geoboard. Record the different (non-congruent) triangles on grid paper, making sure not to repeat any. Keep one triangle on the geoboard. With the rest of your class, sort the triangles by angle measure.
• sort quadrilaterals and regular polygons according to the number of lines of symmetry	► You have been given four 10 cm straws, four 20 cm straws, and four pieces of pipe cleaner to act as corners. Construct and draw quadrilaterals with: 0 lines of symmetry, 1 line, 2 lines, 3 lines, 4 lines. Look at your drawings. Can you predict the number of lines of symmetry a shape will have? Take four more 10 cm straws. Will your prediction work for regular polygons with five to eight sides?
• recognize and describe optical illusions	► Which line is shorter?  Which centre circle is larger? 
• reproduce a given geometric drawing on grid paper	► Sketch a 1 cm grid onto a picture having a geometric design. Reproduce the picture on larger scale grid paper.
• sketch three-dimensional solids and skeletons with or without grids	► A single serving cereal box is 9 cm wide, 3 cm deep, and 12 cm high. Use grid paper to draw a picture of the box. A larger box of the same cereal is three times as wide, deep, and tall. Draw the larger box to actual size on a large sheet of plain paper. Use isometric dot paper to draw the skeleton of a triangular prism. Use plain paper and a ruler to draw the skeleton of a triangular pyramid.

SHAPE AND SPACE (*Transformations*)

Students perform, analyse, and create transformations.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• create, analyse, and describe designs using translations (slides) and reflections (flips)	► Rajinder cut away one side of a regular polygon to make a new shape. Then he slid the shape to the opposite side and fastened it securely with tape. He says the new shape will tessellate and his method of decorating the shape will result in an interesting tiling pattern. Investigate Rajinder's shape. Try your own tessellation, complete with unique decorating and colouring. Report your work in an oral presentation to the class. 
• draw designs using ordered pairs in the first quadrant of the coordinate grid, together with slide and flip images	► Plot these points on a coordinate grid. A (1, 5) D (6, 3) B (1, 3) E (6, 1) C (2, 3) F (5, 1) Describe what combination of translations, rotations, and reflections would move triangle ABC to the position of triangle DEF. Make up a problem with quadrilaterals in place of triangles.

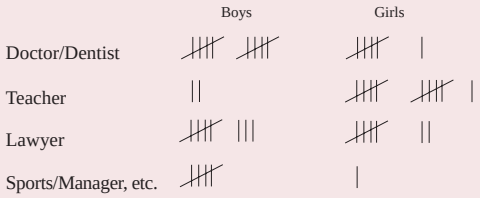
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• formulate a key question from a problem-solving context	► It is Andrea's 13th birthday. She is wondering how many other students in Canada have their 13th birthday today. What questions does she need to ask?
• identify appropriate data sources (first-hand, second-hand, a combination of first- and second-hand) • select and justify appropriate methods of collecting data (designing and using structured questionnaires, experiments, observations, and electronic networks)	► You will often find a relationship between two different body measurements, such as people's head circumference and their height. What are some key questions you might form to guide your investigation of the relationships? Can you predict what conclusion might be expected for each? Write and carry out a plan for investigating one of your questions. Include information on the following: - sources of data - sample size and make-up - method of data collection Find two different ways to display your data so that any relationships between body measurements are clearly revealed. Draw conclusions about your investigation, then compare them to your predictions.
• select and justify the choice of an appropriate population sample to use to answer a particular question	► Ray says the taller the basketball player, the more points the player scores. Tell why each of the following examples would or would not provide an appropriate sample to include in Ray's research to verify his prediction. Consider: - NBA scoring leaders in the last 10 years - all basketball players on a local high school team - the centres on last year's provincial teams - information from a 1990 copy of *World Book Encyclopedia*

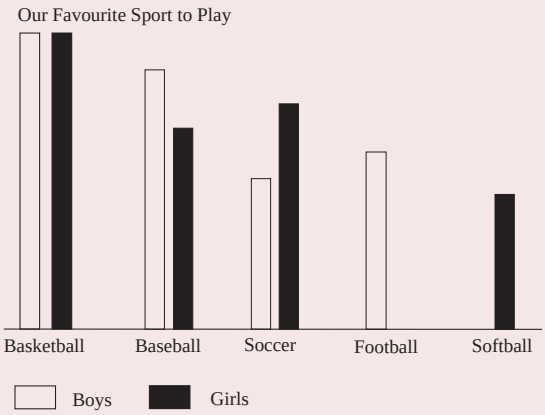
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• discuss how the data collected are affected by the nature of the sample, the method of collection, the sample size, and biases	► Carmen designed and handed out 100 questionnaires to middle year students in her school. One question she asked was: "What do you want to be?" Choose one. ❑ Doctor/Dentist ❑ Teacher ❑ Lawyer ❑ Sports Manager, Coach or Trainer A total of 50 questionnaires were returned. Here are the results.  Carmen concluded that most students will become doctors or dentists. Do you agree with her conclusion? Describe what she might have done differently with: - the wording of her question - her method of gathering data - the sample she chose to survey - the conclusion she reached
• display data by hand or by computer in a variety of ways, including histograms, double bar graphs, and stem and leaf plots	► The magazine *Sports Illustrated for Kids* asked many young people this question: "Have you ever played on a sports team where your mom or dad was the coach?" This table shows the results. Yes: 42.9% (dad), 5.2% (mom), 1.9% (both) No: 50% Display the survey results on two different types of graphs. Give reasons for your choice of graphs.

STATISTICS AND PROBABILITY (*Data Analysis*)

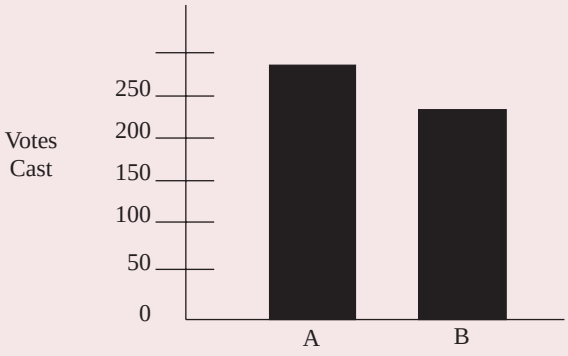
Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• read and interpret graphs that are provided	► Look at this graph showing students' favourite sports.  What are some conclusions you can draw from this graph? Explain your reasoning for each. What important information is not provided by this graph? Could the results be true for the students in your class? Your school? Why?
• describe the general distribution of data: - smallest and largest value - frequency (which occurs most often and least often) - value in the middle - patterns	► Students in a Grade 6 class measured their heights to the nearest centimetre. - What are the least and greatest heights? What type of chart or graph would best reveal the two numbers? - What height occurred more often than any other? What type of chart or graph would best reveal this number? - What height represents the middle of all the heights? How do you know? What type of chart or graph best reveals this? 137 115 153 179 164 143 170 142 129 157 153 128 161 149 139 164 121 138 161 119 140 137 157 136 126 149 143 149

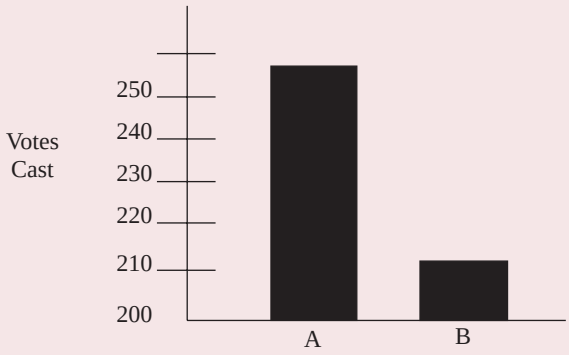
STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• analyse sets of data to make comparisons and test predictions	► Two candidates (A and B) ran for election for school president in 1993. The first graph shows the results. One of the candidates used those results during the 1994 election campaign and prepared the second graph. Can you guess which candidate prepared the 1994 graph? How did the candidate abuse the information?



1993 Actual Results



1993 Results Used in 1994 Campaign

STATISTICS AND PROBABILITY (*Chance and Uncertainty*)

Students use experimental or theoretical probability to represent and solve problems involving uncertainty.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• distinguish between the experimental and theoretical probability of single events	► You have a die with numbers from 1–6. What is the theoretical probability of rolling a 6, a 4, or a 1? Perform an experiment with a die, then compare the results.
• using various polyhedrons as dice, identify the relationship between the number of faces and the probability of a single event • calculate theoretical probability using numbers between 0 and 1	► Draw and label the net of a die to match each statement: - the probability of rolling an odd number is 5/6 - the chance of rolling a prime number is 0/4 - the likelihood of rolling a multiple of two is 5/8
• demonstrate that different outcomes may occur when the same experiment is repeated	► Toss a styrofoam cup onto a flat surface. Repeat several times, noting how often it lands in each position. Repeat for 40 tosses. - How many times did the cup land on its side? Top? Bottom? - How would you express each way as a probability? Side? Top? Bottom? Based on the results of this experiment, predict how many times the cup would land on its top if you tossed it 100 times.
• compare experimental results with theoretical results	► [No example for this prescribed learning outcome.]

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• recognize, model, identify, and describe common multiples, common factors, least common multiples, greatest common factors, and prime factorization	► Josie and Pierre work part-time at a local store. Josie works one day every four days and Pierre works one day every six days. If they both start today and the store is open every day of the week, when will they work together again?
• write whole numbers as expanded numerals using powers of 10 and in scientific notation	► The sun has a diameter of about 1 382 400 km and is about 148 640 000 km from earth. Using kilometres as the unit of length, write these numbers in the following two forms: - using expanded notation with powers of 10 - using scientific notation How would the numbers be affected if metres were used as units of length? What kinds of numbers are best expressed using scientific notation?
• use divisibility rules to determine whether a number is divisible by 2, 3, 4, 5, 6, 8, 9, 10, or 11	► Baseball teams have nine players. If 365 people showed up for a tournament, would there be anyone left over after the teams were made up? Use a divisibility rule to decide without dividing. Represent the 365 people with base-ten blocks and explain why the rule for 9 works. (Hint: how many groups of 9 are there in 100 and 10?)
• read and write numbers to any number of decimal places	► Carl saved his money and bought a mountain bike. His dad had given him $179.49, which was half the cost of the bike. Carl wrote a cheque for the full cost. Show in words and in numbers the amount on the cheque.
• recognize and illustrate that all fractions and mixed numbers can be represented in decimal form (including terminating and repeating decimal fractions)	► Juan was recording the results from probability experiments. The data were gathered as common fractions, but he wanted to write the numbers in decimal form to make it easier to compare results. Whenever possible, he did it mentally, by finding an equivalent common fraction with a denominator that is a power of 10. Finish his work, replacing the question marks with your answers. For which examples does his mental method not work? Explain. $\frac{3}{5} = \frac{6}{10} = 0.6$ $\frac{13}{25} = ?$ $\frac{2}{3} = ?$ $\frac{5}{8} = ?$ $\frac{7}{12} = ?$ $\frac{13}{20} = ?$

NUMBER (*Number Concepts*)

Students use numbers to describe quantities. They represent numbers in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• convert from terminating decimal fractions to common fractions and from single-digit repeating decimal numbers to common fractions using patterns	► Sometimes it is useful to write decimals in common fraction form. For example, it may be easier to visualize $\frac{1}{4}$ of a box of candy than 0.25 of a box. Show how you could write the following decimals as fractions in their lowest terms. 0.245 1.62 Bart used his calculator to express these fractions as decimals. $\frac{1}{9}$ = 0.111..... $\frac{2}{9}$ = 0.222..... $\frac{3}{9}$ = 0.333..... Predict the decimals for $\frac{4}{9}$ and $\frac{7}{9}$. Predict what fraction will have 0.88.... as a decimal. Check your predictions on your calculator. Can you explain the pattern in words?
• demonstrate concretely and pictorially that the sum of opposite integers is 0 • represent integers in a variety of concrete, pictorial, and symbolic ways	► Play a game by tossing a red die and a green die together. For each toss, the red die shows how many points you win and the green die shows how many points you lose. Represent the points you win with red chips and the points you lose with green chips. If each point lost (green chip) can cancel a point won (red chip), show how you would find your score for each toss. How many ways could you get a score of zero (0)?
• compare and order integers	► The following temperatures were recorded for a variety of places across Canada at 3:00 p.m. on a certain day: +8°C, -3°C, -7°C, 0°C, +3°C, -12°C, +10°C. Arrange the temperatures from lowest to highest.

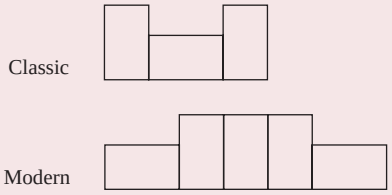
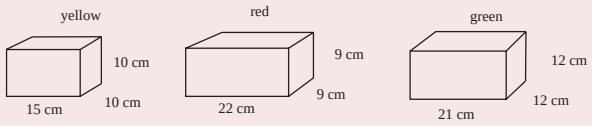
NUMBER (*Number Operations*)

Students demonstrate an understanding of and a proficiency with calculations. They decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• use patterns, manipulatives, and diagrams to demonstrate the concepts of multiplication and division by decimal fractions	► Jacques bought 13.2 m of fabric to make tablecloths. Each tablecloth takes 2.4 m of fabric. How many can he make? Use base-ten blocks to find the answer. Explain how your block answer is related to the one you get on your calculator.
• use estimation strategies to predict or assess the reasonableness of their calculations	► Liam bought three equally priced CDs and a tape priced at $11.95. He paid $71.20 in total. What was the cost of each CD? Before you calculate the exact answer, explain why it must be less than $24.00.
• add, subtract, multiply, and divide decimal fractions (using technology for more than two-digit divisors or multipliers)	► Apples cost $1.39 per kilogram. If you have $6.00, can you purchase a 3.75 kg bag of these apples? Explain how you could make an estimate to be sure, before you purchase the apples. Find the cost of 3.75 kg of apples.
• demonstrate an understanding of the order of operations, using paper and pencil and a calculator	► Place parentheses in the following equation to make it true. $4 + 5 \times 3 - 8 = 19$
• add, subtract, multiply, and divide integers concretely, pictorially, and symbolically	► Hoang explained $+5 \times -2$ as putting five groups of two white chips into a neutral container for a product of -10. He explained $-6 \times +4$ as taking six groups of four black chips out of a neutral container for a product of -24. Using Hoang's reasoning, demonstrate and explain -3×-5 and $+7 \times +6$.
• estimate and calculate percentages	► Alice says that since an increase from 5 to 20 is a 300% increase, then a decrease from 20 to 5 must be a 300% decrease. What is wrong with her reasoning?
• distinguish between *rate* and *ratio*	► From Saskatoon to Regina is a distance of 276 km. What would the rate of travel be if the trip took three hours?
• explain and demonstrate the use of proportion in solving problems	► Geela makes orange paint with five parts yellow to two parts red. If she used six parts red, how many parts yellow would she need?
• mentally convert proper fractions, decimal fractions, and percentages from one to another to facilitate the solution of problems	► Of the 600 people at the basketball game, 25% were with the visiting team. Use mental mathematics to find how many people were with the visiting team.

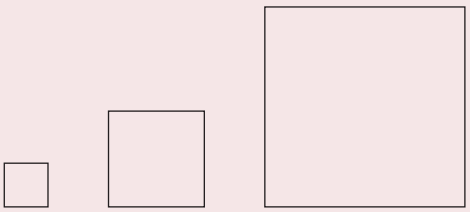
PATTERNS AND RELATIONS (*Patterns*)

Students use patterns to describe the world around them and to solve problems.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• create formulas for finding area, perimeter, and volume • predict and justify the *n*th value of a number pattern • generalize a pattern arising from a problem-solving context using an open number sentence with appropriate variables	► Ms. Fix would like to have a brick border for one side of her garden. She has not yet decided between the two basic patterns, Classic or Modern.  In order to make the brick border long enough, she must repeat the basic pattern a number of times along the side garden's 14.2 m length. At the brickyard, Ms. Fix can choose from three different kinds of bricks.  Write Ms. Fix a note explaining how to choose which bricks to use. Eventually, Ms. Fix decided on the Modern pattern to be repeated 25 times, but she cannot find bricks that she can use. What are the dimensions of the brick she needs? Explain how you got your answer. Write a rule or a formula that Ms. Fix can use to find out how many bricks she needs for any length of border and for any size of brick. Explain how your rule or formula works.

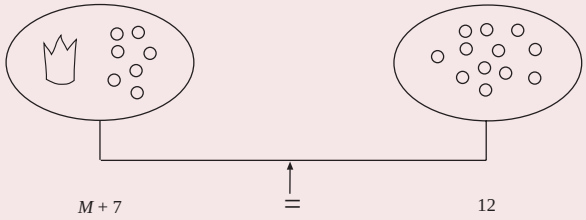
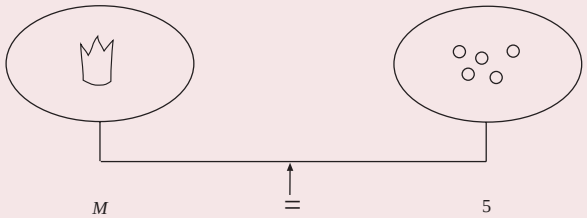
PATTERNS AND RELATIONS (*Variables and Equations*)

Students represent algebraic expressions in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• substitute number variables and compare the results to concrete models and tables	► An expression for the mass of two cans and five marbles is 2 c + 5 m. Find the total mass, if each can has a mass of 200 g and each marble a mass of 75 g.
• write expressions involving variables using standard mathematical conventions	► An equal-arm scale is balanced when there are 3 marbles on one pan and 410 g on the other. Write an equation to show this relationship.
• analyse relations graphically to discover how changes in one quantity may affect others	► [No example for this prescribed learning outcome.]
• graph relations, analyse results, and draw conclusions	► Measure the sides of each of these squares.  What is the perimeter of each square? Make a graph by plotting the length of the sides on the horizontal axis and the perimeters on the vertical axis. Describe the pattern made by the graph. From the results of this graph, make a rule for finding the perimeter of a square. Explain how you could verify your rule.

PATTERNS AND RELATIONS (*Variables and Equations*)

Students represent algebraic expressions in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• solve and verify simple linear equations using a variety of techniques	► Jill had some marbles in a bag. After Jay gave her 7 more, she had 12 marbles in all. How many marbles were in the bag at the start? Jose wrote this equation. M + 7 = 12 He used a balance scale model to solve it. Let  represent the marbles Jill originally had.  He took 7 marbles off each side.  Jill had 5 marbles in the bag. Use Jose's method to show how you would solve Bill's problem. Bill had 6 books. Tereko gave him some more, and then he had 10 books. How many books did Tereko give Bill?

PATTERNS AND RELATIONS (*Variables and Equations*)

Students represent algebraic expressions in multiple ways.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• use patterns and relationships to represent and solve problems by translating everyday language into mathematical symbols and vice versa	► Celine wants to put 12 small square tables together to make one larger rectangular table to use for a class party. She is using square tiles to experiment before she moves the tables. Use 12 tiles to find all possible arrangements and record your solutions on grid paper. Make a chart to show each solution. - What is the area of each large table? - What is the perimeter of each large table? - Which has the smallest perimeter? Try the same experiment with 15 tiles, 24 tiles, and 30 tiles. Compare your results. Is there a relationship between the shape of a table and its perimeter?
• explain how to solve simple problems using informal algebraic methods	► When you double Daniel's age and add 10, you get his mother's age. Write a mathematical expression that shows Daniel's mother's age. Nat had some stamps. He divided them into sets of six to put in his album. He made 17 sets. How many stamps did Nat have?

SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• measure the diameter, radius, and circumference of circles and generalize the relationships	► Gunther gathered a variety of circular objects such as container lids and wheels. For each object, he measured the diameter with calipers and the circumference with a tape measure. He started making this chart. Object / Diameter (cm) / Circumference (cm) / Relationship Between Diameter and Circumference Nut Can Lid Bicycle Wheel Oatmeal Box He noticed a pattern in the relationship between the two measurements for each object. Estimate the relationship between diameter and circumference. Test it by measuring the diameter of an object and predicting the circumference before measuring it. Use your calculator to find the relationship in each case. Make a rule relating the diameter and circumference of a circle.
• solve problems involving circles (radius, diameter, and circumference)	► Elena is making a tablecloth for a round table with a diameter of 90 cm. She wants an overhang of 10 cm. How long a piece of fringe must she buy to go around the edge of the tablecloth?
• explain how time zones are determined	► Investigate how time zones are determined. Write some questions you want answered and decide where you can get the information you need. (You might use school or community libraries or computer searches, for example.) Make a report of your findings.
• determine time in various regions of the world	► If you left Vancouver at 8:25 a.m. (Pacific Standard time) and arrived in Winnipeg at 1:40 p.m. (Central Standard time), how long was your flight?

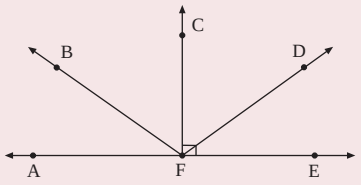
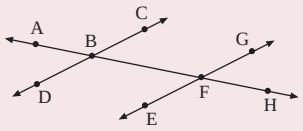
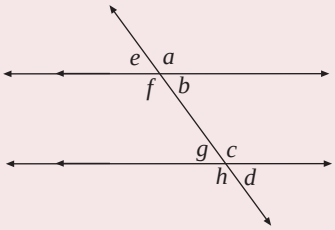
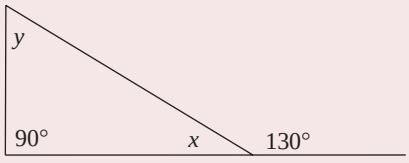
SHAPE AND SPACE (*Measurement*)

Students describe and compare real-world phenomena using either direct or indirect measurement.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• research and report how measurement instruments are used in the community	► Make arrangements to visit businesses and services in your community. Prepare questions about how people use measurement tools. Be sure to consider all types of measure: linear, volume, capacity, area, mass, time, angles, money. Look for common and unique measures and processes of measuring. Make a report on your findings.
• design and construct rectangles, given either or both the perimeter and the area (in whole numbers) • demonstrate and generalize that many rectangles are possible for a given perimeter or given area	► Loretta wants to put 12 small square tables together to make one larger rectangular table to use for a class party. She is using square tiles to experiment before she moves the tables. Use 12 tiles to find all possible arrangements. Use grid paper to record your solutions. Make a chart to show each solution. What is the area of each large table? What is the perimeter of each large table? Which one has the least perimeter? Try the same experiment with 15 tiles, 24 tiles, 30 tiles. Compare your results. Is there a relationship between the shape of a table and its perimeter?

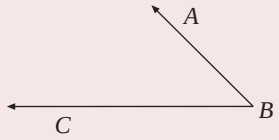
SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• measure and classify pairs of angles, complementary angles (90°), or supplementary angles (180°)	► In the diagram below, name a pair of complementary angles and a pair of supplementary angles. 
• identify and name pairs of angles pertaining to parallel lines and transversals, including: - corresponding angles - vertically opposite angles - interior angles on the same side of the transversal - exterior angles on the same side of the transversal - interior alternate angles	► In the diagram below, name pairs of angles that are: - corresponding - vertically opposite - interior on the same side of the transversal - exterior on the same side of the transversal - interior alternate angles 
• describe the relationships between the pairs of angles pertaining to parallel lines and transversals	► If a is 100°, calculate the measures of each of the other angles. Justify each calculation. 
• use mathematical reasoning to determine the measures of angles in a diagram • perform calculations with angle measures	► Find the measures of the indicated angles in this diagram. 

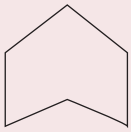
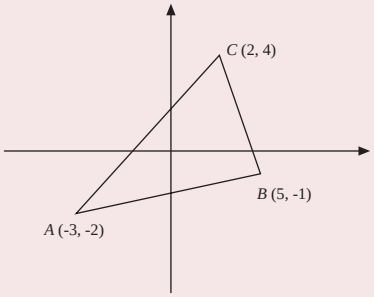
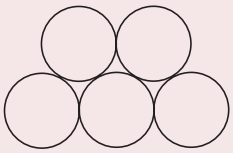
SHAPE AND SPACE (*3-D Objects and 2-D Shapes*)

Students describe the characteristics of three-dimensional (3-D) objects and two-dimensional (2-D) shapes and analyse the relationships among them.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• construct angle bisectors and perpendicular bisectors	► Construct the bisector of ∠ABC. 
• explain in more than one way why the sum of the measures of the angles of a triangle is 180°	► Myra drew and cut out several triangles of different sizes and shapes. She marked the vertices and cut off the three vertices of each triangle. Make some triangles like Myra's, and explain how you can use the three vertices from each triangle to show that their sum is 180°.

SHAPE AND SPACE (*Transformations*)

Students perform, analyse, and create transformations.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• create, analyse, and describe designs using rotations (turns), reflections (flips), and translations (slides)	► Make a design by drawing this figure on paper and making four turn images of the figure.  Describe the turn centre, direction, and degree of each turn so someone else, given the same figure, can replicate your design.
• use informal concepts of congruence to describe images after rotations (turns), reflections (flips), and translations (slides)	► State the coordinates of A, B, and C after the slide (R3, U4). Draw the image and compare the image to the original triangle. 
• draw designs using ordered pairs in all four quadrants of the coordinate grid, together with slide and flip images	► A triangle has vertices (3, 2), (6, 2), and (6, 4). It is flipped into the 2nd quadrant with the y-axis as the mirror line. This image is flipped into the 3rd quadrant with the x-axis as the mirror line; and this image is flipped into the 4th quadrant with the y-axis as the mirror line. Draw the three images and give the coordinates of each vertex of each triangle.
• connect reflections with lines and planes of symmetry	► Draw in and label the line(s) of symmetry. 

STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• formulate questions that explore whether or not a relationship exists in a real-world context • select and justify appropriate methods of collecting data (designing and using questionnaires, interviews, experiments, research) • display data by hand or by computer in a variety of ways, including circle graphs	► Design a questionnaire containing five questions to obtain information you would like from your classmates. Design at least one question to collect numerical data. - Survey 10 students, keeping track of the results. - Complete the survey by giving the questionnaire to the remainder of the students. Compare your results from the first 10 students with those from a survey of all Grade 7 students, using the same questionnaire. What may account for any differences or similarities? Enter the data into a database, after setting up the necessary categories. Use some of the features of the database to create two or three different reports, using a variety of the information collected. Enter the numerical data into a spreadsheet and have the computer generate two or three different types of graphs. Which graph is most effective in displaying information. Why? What conclusions can you draw from the data collected?
• read and interpret graphs that are provided	► Find some graphs in your local newspaper. Working in a group, discuss the following questions: - Does the data give the information indicated? - Is the type of graph appropriate for the data? - Have scales, pictures, or data groupings been selected to distort data? - Does the graph present data clearly? Is it visually appealing?

STATISTICS AND PROBABILITY (*Data Analysis*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• determine measures of central tendency for a set of data: - mode - median - mean	► One measure of central tendency for a set of five numbers is 23. What might the numbers be? Find an example for each measure of central tendency.
• determine measures of the distribution of a set of data: - range - extremes, gaps, and clusters - quartiles	► [No example for this prescribed learning outcome.]
• interpolate from data to make predictions	► Collect data on the population of your school over the last 10 years. Graph the information. - What would you predict the school population will be in six years? What trends do you see in the population? Can you suggest any reasons for these trends? - Would enrolment figures suggest a need to increase the size of your school facility in the next 10 years? Why or why not?

STATISTICS AND PROBABILITY (*Chance and Uncertainty*)

Students use experimental or theoretical probability to represent and solve problems involving uncertainty.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• use a table to identify all possible outcomes of two independent events	► For a picnic, Rosanna prepared three kinds of sandwiches: ham, chicken, and cheese. She also wrapped up pieces of apple and cherry pie. Pauloosi picked a sandwich and a piece of pie. Make a table to show all the possible combinations of sandwiches and pie Pauloosi could have picked. Rosanna prepared 5 ham sandwiches, 6 chicken sandwiches, and 4 cheese sandwiches. Pauloosi's favourite is chicken. If he chooses without looking, what is the probability that he will get his favourite?
• use simulation or experimentation to solve probability problems	► A breakfast cereal company has randomly placed one of four prizes in each cereal box it manufactures. How many cereal boxes do you need to buy to be sure you will collect at least one of each prize? Use the Monte Carlo method to find out how many cereal boxes you will need. Choose either a four-sided die, or a spinner with four 90° sectors. Then complete a chart like the following, documenting the number of throws or spins required to get at least one of each prize.

Trial	Prize 1	Prize 2	Prize 3	Prize 4	Total Spins/Throws
1	||||	|||	||||	|	12
2					
3					
4					
5					
...					

In Trial 1, it took 12 throws to get at least one tally mark in each column. This would imply that 12 boxes of cereal would need to be purchased in order to get at least one of each prize. Try some more trials and compare the results.

STATISTICS AND PROBABILITY (*Chance and Uncertainty*)

Students collect, display, and analyse data to make predictions about a population.

Prescribed Learning Outcomes	Illustrative Examples
It is expected that students will:	
• create and solve problems using the definition of probability as favourable outcomes over total outcomes	► In pairs, draw a card from a deck of playing cards and record its value, regardless of the suit. Replace the card and draw again, recording the results. After doing this experiment 20 times, calculate the probability of drawing a jack from a standard deck of cards. Compare your results with another pair. Calculate the probability of drawing a jack based on the combined results of the class. Compare the results from your pair with those of the class. Calculate the theoretical probability of drawing a jack from a regular deck of cards and compare it to the experimental results.