The Alberta
K–9 MATHEMATICS

Program of Studies with Achievement Indicators

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The Alberta K–9 Mathematics Program of Studies

with Achievement Indicators

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BACKGROUND

The Western Canadian Protocol for Collaboration in Basic Education Kindergarten to Grade 12 was signed in December 1993 by the Ministers of Education from Alberta, British Columbia, Manitoba, Northwest Territories, Saskatchewan and Yukon Territory. In February 2000, following the addition of Nunavut, the protocol was renamed the Western and Northern Canadian Protocol (WNCP) for Collaboration in Basic Education (Kindergarten to Grade 12).

WNCP jurisdictions:
Alberta
British Columbia
Manitoba
Northwest Territories
Nunavut
Saskatchewan
Yukon Territory

In 2005, the Ministers of Education from all the WNCP jurisdictions unanimously concurred with the rationale of the original partnership because of the importance placed on:

- common educational goals
- the ability to collaborate to achieve common goals
- high standards in education
- planning an array of educational opportunities
- removing obstacles to accessibility for individual learners
- optimum use of limited educational resources.

The Common Curriculum Framework for K–9 Mathematics: Western and Northern Canadian Protocol, May 2006, was developed by the seven ministries of education in collaboration with teachers, administrators, parents, business representatives, post-secondary educators and others.

The framework identifies beliefs about mathematics, general and specific student outcomes, and achievement indicators agreed upon by the seven jurisdictions. Each of the provinces and territories is to determine when and how the framework will be implemented within its own jurisdiction.

INTRODUCTION

PURPOSE OF THE DOCUMENT

The program of studies communicates high expectations for students.

The *Alberta K–9 Mathematics Program of Studies with Achievement Indicators* has been derived from *The Common Curriculum Framework for K–9 Mathematics: Western and Northern Canadian Protocol*, May 2006 (the Common Curriculum Framework). The program of studies incorporates the conceptual framework for Kindergarten to Grade 9 Mathematics and the general outcomes, specific outcomes and achievement indicators that were established in the Common Curriculum Framework.

BELIEFS ABOUT STUDENTS AND MATHEMATICS LEARNING

Mathematical understanding is fostered when students build on their own experiences and prior knowledge.

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

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

The learning environment should value and respect the diversity of students' experiences and ways of thinking, so that students are comfortable taking intellectual risks, asking questions and posing conjectures. Students need to explore problem-solving situations in order to develop personal strategies and become mathematically literate. They must realize that it is acceptable to solve problems in a variety of ways and that a variety of solutions may be acceptable.

FIRST NATIONS, MÉTIS AND INUIT PERSPECTIVES

Teachers need to understand the diversity of students' cultures and experiences.

First Nations, Métis and Inuit students in northern and western Canada come from diverse geographic areas with varied cultural and linguistic backgrounds. Students attend schools in a variety of settings, including urban, rural and isolated communities. Teachers need to understand the diversity of students' cultures and experiences.

First Nations, Métis and Inuit students often have a holistic view of the environment—they look for connections in learning and learn best when mathematics is contextualized. They may come from cultures where learning takes place through active participation. Traditionally, little emphasis was placed upon the written word, so oral communication and practical applications and experiences are important to student learning and understanding. By understanding and responding to nonverbal cues, teachers can optimize student learning and mathematical understanding.

A variety of teaching and assessment strategies help build upon the diverse knowledge, cultures, communication styles, skills, attitudes, experiences and learning styles of students.

Research indicates that when strategies go beyond the incidental inclusion of topics and objects unique to a culture or region, greater levels of understanding can be achieved (Banks and Banks, 1993).

AFFECTIVE DOMAIN

To experience success, students must be taught to set achievable goals and assess themselves as they work toward these goals.

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

Teachers, students and parents need to recognize the relationship between the affective and cognitive domains, and attempt to nurture those aspects of the affective domain that contribute to positive attitudes. To experience success, students must be taught to set achievable goals and assess themselves as they work toward these goals.

Striving toward success and becoming autonomous and responsible learners are ongoing, reflective processes that involve revisiting the setting and assessing of personal goals.

EARLY CHILDHOOD

Young children are naturally curious and develop a variety of mathematical ideas before they enter Kindergarten. Children make sense of their environment through observations and interactions at home, in daycares, in preschools and in the community. Mathematics learning is embedded in everyday activities, such as playing, reading, beading, baking, storytelling and helping around the home.

Curiosity about mathematics is fostered when children are actively engaged in their environment.

Activities can contribute to the development of number and spatial sense in children. Curiosity about mathematics is fostered when children are engaged in, and talking about, such activities as comparing quantities, searching for patterns, sorting objects, ordering objects, creating designs and building with blocks.

Positive early experiences in mathematics are as critical to child development as are early literacy experiences.

GOALS FOR STUDENTS

Mathematics education must prepare students to use mathematics confidently to solve problems.

The main goals of mathematics education are to prepare students to:

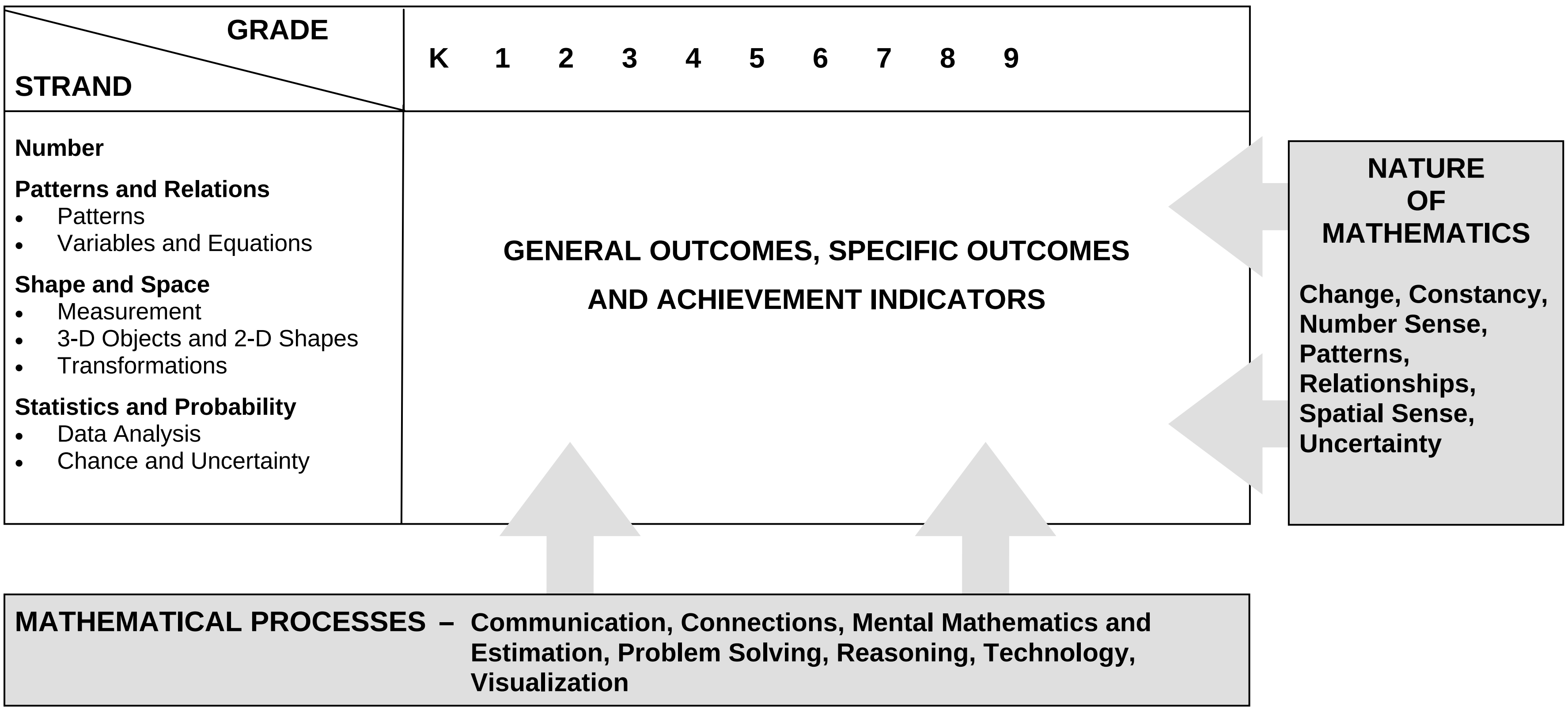
- use mathematics confidently to solve problems
- communicate and reason mathematically
- appreciate and value mathematics
- make connections between mathematics and its applications
- commit themselves to lifelong learning
- become mathematically literate adults, using mathematics to contribute to society.

Students who have met these goals will:

- gain understanding and appreciation of the contributions of mathematics as a science, philosophy and art
- exhibit a positive attitude toward mathematics
- engage and persevere in mathematical tasks and projects
- contribute to mathematical discussions
- take risks in performing mathematical tasks
- exhibit curiosity.

CONCEPTUAL FRAMEWORK FOR K–9 MATHEMATICS

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



MATHEMATICAL PROCESSES

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

Students are expected to:

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

The program of studies incorporates these seven interrelated mathematical processes that are intended to permeate teaching and learning.

Communication [C]

Students need opportunities to read about, represent, view, write about, listen to and discuss mathematical ideas. These opportunities allow students to create links between their own language and ideas, and the formal language and symbols of mathematics.

Students must be able to communicate mathematical ideas in a variety of ways and contexts.

Communication is important in clarifying, reinforcing and modifying ideas, attitudes and beliefs about mathematics. Students should be encouraged to use a variety of forms of communication while learning mathematics. Students also need to communicate their learning using mathematical terminology.

Communication helps students make connections among concrete, pictorial, symbolic, oral, written and mental representations of mathematical ideas.

Connections [CN]

Through connections, students begin to view mathematics as useful and relevant.

Contextualization and making connections to the experiences of learners are powerful processes in developing mathematical understanding. This can be particularly true for First Nations, Métis and Inuit learners. When mathematical ideas are connected to each other or to real-world phenomena, students begin to view mathematics as useful, relevant and integrated.

Learning mathematics within contexts and making connections relevant to learners can validate past experiences and increase student willingness to participate and be actively engaged.

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

Mental Mathematics and Estimation [ME]

Mental mathematics is a combination of cognitive strategies that enhance flexible thinking and number sense. It is calculating mentally without the use of external memory aids.

Mental mathematics and estimation are fundamental components of number sense.

Mental mathematics enables students to determine answers without paper and pencil. It improves computational fluency by developing efficiency, accuracy and flexibility.

"Even more important than performing computational procedures or using calculators is the greater facility that students need—more than ever before—with estimation and mental math" (National Council of Teachers of Mathematics, May 2005).

Students proficient with mental mathematics "become liberated from calculator dependence, build confidence in doing mathematics, become more flexible thinkers and are more able to use multiple approaches to problem solving" (Rubenstein, 2001, p. 442).

Mental mathematics "provides the cornerstone for all estimation processes, offering a variety of alternative algorithms and nonstandard techniques for finding answers" (Hope, 1988, p. v).

Estimation is used for determining approximate values or quantities or for determining the reasonableness of calculated values. It often uses benchmarks or referents. Students need to know when to estimate, how to estimate and what strategy to use.

Estimation assists individuals in making mathematical judgements and in developing useful, efficient strategies for dealing with situations in daily life.

Problem Solving [PS]

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

Learning through problem solving should be the focus of mathematics at all grade levels.

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

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

Reasoning [R]

Mathematical reasoning helps students think logically and make sense of mathematics. Students need to develop confidence in their abilities to reason and justify their mathematical thinking. High-order questions challenge students to think and develop a sense of wonder about mathematics.

Mathematical reasoning helps students think logically and make sense of mathematics.

Mathematical experiences in and out of the classroom provide opportunities for students to develop their ability to reason. Students can explore and record results, analyze observations, make and test generalizations from patterns, and reach new conclusions by building upon what is already known or assumed to be true.

Reasoning skills allow students to use a logical process to analyze a problem, reach a conclusion and justify or defend that conclusion.

Technology [T]

Technology contributes to the learning of a wide range of mathematical outcomes and enables students to explore and create patterns, examine relationships, test conjectures and solve problems.

Technology contributes to the learning of a wide range of mathematical outcomes and enables students to explore and create patterns, examine relationships, test conjectures and solve problems.

Calculators and computers can be used to:

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

Technology contributes to a learning environment in which the growing curiosity of students can lead to rich mathematical discoveries at all grade levels.

Visualization [V]

Visualization "involves thinking in pictures and images, and the ability to perceive, transform and recreate different aspects of the visual-spatial world" (Armstrong, 1993, p. 10). The use of visualization in the study of mathematics provides students with opportunities to understand mathematical concepts and make connections among them.

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

Visual images and visual reasoning are important components of number, spatial and measurement sense. Number visualization occurs when students create mental representations of numbers.

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

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

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

NATURE OF MATHEMATICS

- *Change*
- *Constancy*
- *Number Sense*
- *Patterns*
- *Relationships*
- *Spatial Sense*
- *Uncertainty*

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

Change

It is important for students to understand that mathematics is dynamic and not static. As a result, recognizing change is a key component in understanding and developing mathematics.

Change is an integral part of mathematics and the learning of mathematics.

Within mathematics, students encounter conditions of change and are required to search for explanations of that change. To make predictions, students need to describe and quantify their observations, look for patterns, and describe those quantities that remain fixed and those that change. For example, the sequence 4, 6, 8, 10, 12, … can be described as:

- the number of a specific colour of beads in each row of a beaded design
- skip counting by 2s, starting from 4
- an arithmetic sequence, with first term 4 and a common difference of 2
- a linear function with a discrete domain

(Steen, 1990, p. 184).

Constancy

Constancy is described by the terms stability, conservation, equilibrium, steady state and symmetry.

Different aspects of constancy are described by the terms stability, conservation, equilibrium, steady state and symmetry (AAAS–Benchmarks, 1993, p. 270). Many important properties in mathematics and science relate to properties that do not change when outside conditions change. Examples of constancy include the following:

- The ratio of the circumference of a teepee to its diameter is the same regardless of the length of the teepee poles.
- The sum of the interior angles of any triangle is 180°.
- The theoretical probability of flipping a coin and getting heads is 0.5.

Some problems in mathematics require students to focus on properties that remain constant. The recognition of constancy enables students to solve problems involving constant rates of change, lines with constant slope, direct variation situations or the angle sums of polygons.

Number Sense

An intuition about number is the most important foundation of a numerate child.

Number sense, which can be thought of as intuition about numbers, is the most important foundation of numeracy (British Columbia Ministry of Education, 2000, p. 146).

A true sense of number goes well beyond the skills of simply counting, memorizing facts and the situational rote use of algorithms. Mastery of number facts is expected to be attained by students as they develop their number sense. This mastery allows for facility with more complex computations but should not be attained at the expense of an understanding of number.

Number sense develops when students connect numbers to their own real-life experiences and when students use benchmarks and referents. This results in students who are computationally fluent and flexible with numbers and who have intuition about numbers. The evolving number sense typically comes as a by-product of learning rather than through direct instruction. However, number sense can be developed by providing rich mathematical tasks that allow students to make connections to their own experiences and their previous learning.

Patterns

Mathematics is about recognizing, describing and working with numerical and non-numerical patterns. Patterns exist in all strands of this program of studies.

Working with patterns enables students to make connections within and beyond mathematics. These skills contribute to students' interaction with, and understanding of, their environment.

Mathematics is about recognizing, describing and working with numerical and non-numerical patterns.

Patterns may be represented in concrete, visual or symbolic form. Students should develop fluency in moving from one representation to another.

Students must learn to recognize, extend, create and use mathematical patterns. Patterns allow students to make predictions and justify their reasoning when solving routine and nonroutine problems.

Learning to work with patterns in the early grades helps students develop algebraic thinking, which is foundational for working with more abstract mathematics in higher grades.

Relationships

Mathematics is used to describe and explain relationships.

Mathematics is one way to describe interconnectedness in a holistic worldview. Mathematics is used to describe and explain relationships. As part of the study of mathematics, students look for relationships among numbers, sets, shapes, objects and concepts. The search for possible relationships involves collecting and analyzing data and describing relationships visually, symbolically, orally or in written form.

Spatial Sense

Spatial sense offers a way to interpret and reflect on the physical environment.

Spatial sense involves visualization, mental imagery and spatial reasoning. These skills are central to the understanding of mathematics.

Spatial sense is developed through a variety of experiences and interactions within the environment. The development of spatial sense enables students to solve problems involving 3-D objects and 2-D shapes and to interpret and reflect on the physical environment and its 3-D or 2-D representations.

Some problems involve attaching numerals and appropriate units (measurement) to dimensions of shapes and objects. Spatial sense allows students to make predictions about the results of changing these dimensions; e.g., doubling the length of the side of a square increases the area by a factor of four. Ultimately, spatial sense enables students to communicate about shapes and objects and to create their own representations.

Uncertainty

Uncertainty is an inherent part of making predictions.

In mathematics, interpretations of data and the predictions made from data may lack certainty.

Events and experiments generate statistical data that can be used to make predictions. It is important to recognize that these predictions (interpolations and extrapolations) are based upon patterns that have a degree of uncertainty.

The quality of the interpretation is directly related to the quality of the data. An awareness of uncertainty allows students to assess the reliability of data and data interpretation.

Chance addresses the predictability of the occurrence of an outcome. As students develop their understanding of probability, the language of mathematics becomes more specific and describes the degree of uncertainty more accurately.

STRANDS

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

The learning outcomes in the program of studies are organized into four strands across the grades K–9. Some strands are subdivided into substrands. There is one general outcome per substrand across the grades K–9.

The strands and substrands, including the general outcome for each, follow.

Number

- Develop number sense.

Patterns and Relations

Patterns

- Use patterns to describe the world and to solve problems.

Variables and Equations

- Represent algebraic expressions in multiple ways.

Shape and Space

Measurement

- Use direct and indirect measurement to solve problems.

3-D Objects and 2-D Shapes

- Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Transformations

- Describe and analyze position and motion of objects and shapes.

Statistics and Probability

Data Analysis

- Collect, display and analyze data to solve problems.

Chance and Uncertainty

- Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.

OUTCOMES AND ACHIEVEMENT INDICATORS

The program of studies is stated in terms of general outcomes, specific outcomes and achievement indicators.

General outcomes

General outcomes are overarching statements about what students are expected to learn in each strand/substrand. The general outcome for each strand/substrand is the same throughout the grades.

Specific outcomes

Specific outcomes are statements that identify the specific skills, understanding and knowledge that students are required to attain by the end of a given grade.

Achievement indicators

Achievement indicators are samples of how students may demonstrate their achievement of the goals of a specific outcome. The range of samples provided is meant to reflect the scope of the specific outcome. Achievement indicators are context-free.

In the specific outcomes, the word *including* indicates that any ensuing items must be addressed to fully meet the learning outcome. The phrase *such as* indicates that the ensuing items are provided for illustrative purposes or clarification, and are not requirements that must be addressed to fully meet the learning outcome.

LINKS TO INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) OUTCOMES

Some curriculum outcomes from Alberta Education's Information and Communication Technology (ICT) Program of Studies can be linked to outcomes in the mathematics program so that students will develop a broad perspective on the nature of technology, learn how to use and apply a variety of technologies, and consider the impact of ICT on individuals and society. The connection to ICT outcomes supports and reinforces the understandings and abilities that students are expected to develop through the general and specific outcomes of the mathematics program. Effective, efficient and ethical application of ICT outcomes contributes to the mathematics program vision.

Links to the ICT outcomes have been identified for some specific outcomes. These links appear in square brackets below the process codes for an outcome, where appropriate. The complete wording of the relevant outcomes for ICT is provided in the Appendix.

SUMMARY

The conceptual framework for K–9 mathematics describes the nature of mathematics, mathematical processes and the mathematical concepts to be addressed in Kindergarten to Grade 9 mathematics. The components are not meant to stand alone. Activities that take place in the mathematics classroom should stem from a problem-solving approach, be based on mathematical processes and lead students to an understanding of the nature of mathematics through specific knowledge, skills and attitudes among and between strands.

INSTRUCTIONAL FOCUS

The program of studies is arranged into four strands. These strands are not intended to be discrete units of instruction. The integration of outcomes across strands makes mathematical experiences meaningful. Students should make the connection between concepts both within and across strands.

Consider the following when planning for instruction:

- Integration of the mathematical processes within each strand is expected.
- By decreasing emphasis on rote calculation, drill and practice, and the size of numbers used in paper and pencil calculations, more time is available for concept development.
- Problem solving, reasoning and connections are vital to increasing mathematical fluency and must be integrated throughout the program.
- There is to be a balance among mental mathematics and estimation, paper and pencil exercises, and the use of technology, including calculators and computers. Concepts should be introduced using manipulatives and be developed concretely, pictorially and symbolically.
- Students bring a diversity of learning styles and cultural backgrounds to the classroom. They will be at varying developmental stages.

GENERAL AND SPECIFIC OUTCOMES

GENERAL AND SPECIFIC OUTCOMES BY STRAND (pages 18–51)

This section presents the general and specific outcomes for each strand, for Kindergarten through Grade 9.

GENERAL AND SPECIFIC OUTCOMES WITH ACHIEVEMENT INDICATORS (pages 52–157)

This section presents general and specific outcomes with corresponding achievement indicators and is organized by strand within each grade. The list of indicators contained in this section is not intended to be exhaustive but rather to provide teachers with examples of evidence of understanding that may be used to determine whether or not students have achieved a given specific outcome. Teachers may use any number of these indicators or choose to use other indicators as evidence that the desired learning has been achieved. Achievement indicators should also help teachers form a clear picture of the intent and scope of each specific outcome.

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

GENERAL AND SPECIFIC OUTCOMES BY STRAND

Number

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
General Outcome Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.
Specific Outcomes 1. Say the number sequence 1 to 10 by 1s, starting anywhere from 1 to 10 and from 10 to 1. [C, CN, V] 2. Subitize (recognize at a glance) and name familiar arrangements of 1 to 5 objects or dots. [C, CN, ME, V] 3. Relate a numeral, 1 to 10, to its respective quantity. [CN, R, V] 4. Represent and describe numbers 2 to 10, concretely and pictorially. [C, CN, ME, R, V] 5. Compare quantities 1 to 10, using one-to-one correspondence. [C, CN, V]	**Specific Outcomes** 1. Say the number sequence 0 to 100 by: • 1s forward between any two given numbers • 1s backward from 20 to 0 • 2s forward from 0 to 20 • 5s and 10s forward from 0 to 100. [C, CN, ME, V] 2. Subitize (recognize at a glance) and name familiar arrangements of 1 to 10 objects or dots. [C, CN, ME, V] 3. Demonstrate an understanding of counting by: • indicating that the last number said identifies “how many” • showing that any set has only one count • using the counting-on strategy • using parts or equal groups to count sets. [C, CN, ME, R, V]	**Specific Outcomes** 1. Say the number sequence 0 to 100 by: • 2s, 5s and 10s, forward and backward, using starting points that are multiples of 2, 5 and 10 respectively • 10s, using starting points from 1 to 9 • 2s, starting from 1. [C, CN, ME, R] 2. Demonstrate if a number (up to 100) is even or odd. [C, CN, PS, R] 3. Describe order or relative position, using ordinal numbers (up to tenth). [C, CN, R] 4. Represent and describe numbers to 100, concretely, pictorially and symbolically. [C, CN, V]	**Specific Outcomes** 1. Say the number sequence 0 to 1000 forward and backward by: • 5s, 10s or 100s, using any starting point • 3s, using starting points that are multiples of 3 • 4s, using starting points that are multiples of 4 • 25s, using starting points that are multiples of 25. [C, CN, ME] 2. Represent and describe numbers to 1000, concretely, pictorially and symbolically. [C, CN, V] 3. Compare and order numbers to 1000. [C, CN, R, V] 4. Estimate quantities less than 1000, using referents. [ME, PS, R, V]	**Specific Outcomes** 1. Represent and describe whole numbers to 10 000, pictorially and symbolically. [C, CN, V] 2. Compare and order numbers to 10 000. [C, CN, V] 3. Demonstrate an understanding of addition of numbers with answers to 10 000 and their corresponding subtractions (limited to 3- and 4-digit numerals) by: • using personal strategies for adding and subtracting • estimating sums and differences • solving problems involving addition and subtraction. [C, CN, ME, PS, R]

Number

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.
Specific Outcomes 1. Represent and describe whole numbers to 1 000 000. [C, CN, V, T] [ICT: C6–2.2] 2. Use estimation strategies, including: • front-end rounding • compensation • compatible numbers in problem-solving contexts. [C, CN, ME, PS, R, V] 3. Apply mental mathematics strategies and number properties, such as: • skip counting from a known fact • using doubling or halving • using patterns in the 9s facts • using repeated doubling or halving to determine, with fluency, answers for basic multiplication facts to 81 and related division facts. [C, CN, ME, R, V]	**Specific Outcomes** 1. Demonstrate an understanding of place value, including numbers that are: • greater than one million • less than one thousandth. [C, CN, R, T] 2. Solve problems involving whole numbers and decimal numbers. [ME, PS, T] [ICT: C6–2.4] 3. Demonstrate an understanding of factors and multiples by: • determining multiples and factors of numbers less than 100 • identifying prime and composite numbers • solving problems using multiples and factors. [CN, PS, R, V] 4. Relate improper fractions to mixed numbers and mixed numbers to improper fractions. [CN, ME, R, V]	**Specific Outcomes** 1. Determine and explain why a number is divisible by 2, 3, 4, 5, 6, 8, 9 or 10, and why a number cannot be divided by 0. [C, R] 2. Demonstrate an understanding of the addition, subtraction, multiplication and division of decimals to solve problems (for more than 1-digit divisors or 2-digit multipliers, the use of technology is expected). [ME, PS, T] [ICT: P2–3.4] 3. Solve problems involving percents from 1% to 100%. [C, CN, PS, R, T] [ICT: P2–3.4] 4. Demonstrate an understanding of the relationship between positive terminating decimals and positive fractions and between positive repeating decimals and positive fractions. [C, CN, R, T] [ICT: P2–3.4]	**Specific Outcomes** 1. Demonstrate an understanding of perfect squares and square roots, concretely, pictorially and symbolically (limited to whole numbers). [C, CN, R, V] 2. Determine the approximate square root of numbers that are not perfect squares (limited to whole numbers). [C, CN, ME, R, T] [ICT: P2–3.4] 3. Demonstrate an understanding of percents greater than or equal to 0%, including greater than 100%. [CN, PS, R, V] 4. Demonstrate an understanding of ratio and rate. [C, CN, V]	**Specific Outcomes** 1. Demonstrate an understanding of powers with integral bases (excluding base 0) and whole number exponents by: • representing repeated multiplication, using powers • using patterns to show that a power with an exponent of zero is equal to one • solving problems involving powers. [C, CN, PS, R] 2. Demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole number exponents: • $(a^m)(a^n) = a^{m+n}$ • $a^m \div a^n = a^{m-n}, m > n$ • $(a^m)^n = a^{mn}$ • $(ab)^m = a^m b^m$ • $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0.$ [C, CN, PS, R, T] [ICT: P2–3.4]

Number (continued)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
	General Outcome Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.
	Specific Outcomes 4. Represent and describe numbers to 20, concretely, pictorially and symbolically. [C, CN, V] 5. Compare sets containing up to 20 elements, using: • referents • one-to-one correspondence to solve problems. [C, CN, ME, PS, R, V] 6. Estimate quantities to 20 by using referents. [C, CN, ME, PS, R, V] 7. Demonstrate an understanding of conservation of number. [C, R, V] 8. Identify the number, up to 20, that is: • one more • two more • one less • two less than a given number. [C, CN, ME, R, V]	**Specific Outcomes** 5. Compare and order numbers up to 100. [C, CN, ME, R, V] 6. Estimate quantities to 100, using referents. [C, ME, PS, R] 7. Illustrate, concretely and pictorially, the meaning of place value for numerals to 100. [C, CN, R, V] 8. Demonstrate and explain the effect of adding zero to, or subtracting zero from, any number. [C, R]	**Specific Outcomes** 5. Illustrate, concretely and pictorially, the meaning of place value for numerals to 1000. [C, CN, R, V] 6. Describe and apply mental mathematics strategies for adding two 2-digit numerals, such as: • adding from left to right • taking one addend to the nearest multiple of ten and then compensating • using doubles. [C, CN, ME, PS, R, V] 7. Describe and apply mental mathematics strategies for subtracting two 2-digit numerals, such as: • taking the subtrahend to the nearest multiple of ten and then compensating • thinking of addition • using doubles. [C, CN, ME, PS, R, V]	**Specific Outcomes** 4. Apply the properties of 0 and 1 for multiplication and the property of 1 for division. [C, CN, R] 5. Describe and apply mental mathematics strategies, such as: • skip counting from a known fact • using doubling or halving • using doubling or halving and adding or subtracting one more group • using patterns in the 9s facts • using repeated doubling to determine basic multiplication facts to 9×9 and related division facts. [C, CN, ME, R]

Number (continued)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.
Specific Outcomes 4. Apply mental mathematics strategies for multiplication, such as: • annexing then adding zero • halving and doubling • using the distributive property. [C, CN, ME, R, V] 5. Demonstrate, with and without concrete materials, an understanding of multiplication (2-digit by 2-digit) to solve problems. [C, CN, PS, V] 6. Demonstrate, with and without concrete materials, an understanding of division (3-digit by 1-digit), and interpret remainders to solve problems. [C, CN, ME, PS, R, V]	**Specific Outcomes** 5. Demonstrate an understanding of ratio, concretely, pictorially and symbolically. [C, CN, PS, R, V] 6. Demonstrate an understanding of percent (limited to whole numbers), concretely, pictorially and symbolically. [C, CN, PS, R, V] 7. Demonstrate an understanding of integers, concretely, pictorially and symbolically. [C, CN, R, V]	**Specific Outcomes** 5. Demonstrate an understanding of adding and subtracting positive fractions and mixed numbers, with like and unlike denominators, concretely, pictorially and symbolically (limited to positive sums and differences). [C, CN, ME, PS, R, V] 6. Demonstrate an understanding of addition and subtraction of integers, concretely, pictorially and symbolically. [C, CN, PS, R, V]	**Specific Outcomes** 5. Solve problems that involve rates, ratios and proportional reasoning. [C, CN, PS, R] 6. Demonstrate an understanding of multiplying and dividing positive fractions and mixed numbers, concretely, pictorially and symbolically. [C, CN, ME, PS] 7. Demonstrate an understanding of multiplication and division of integers, concretely, pictorially and symbolically. [C, CN, PS, R, V]	**Specific Outcomes** 3. Demonstrate an understanding of rational numbers by: • comparing and ordering rational numbers • solving problems that involve arithmetic operations on rational numbers. [C, CN, PS, R, T, V] [ICT: P2–3.4] 4. Explain and apply the order of operations, including exponents, with and without technology. [PS, T] [ICT: P2–3.4] 5. Determine the square root of positive rational numbers that are perfect squares. [C, CN, PS, R, T] [ICT: P2–3.4]

Number (continued)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
	General Outcome Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.
	Specific Outcomes 9. Demonstrate an understanding of addition of numbers with answers to 20 and their corresponding subtraction facts, concretely, pictorially and symbolically, by: • using familiar mathematical language to describe additive and subtractive actions • creating and solving problems in context that involve addition and subtraction • modelling addition and subtraction, using a variety of concrete and visual representations, and recording the process symbolically. [C, CN, ME, PS, R, V]	**Specific Outcomes** 9. Demonstrate an understanding of addition (limited to 1- and 2-digit numerals) with answers to 100 and the corresponding subtraction by: • using personal strategies for adding and subtracting with and without the support of manipulatives • creating and solving problems that involve addition and subtraction • using the commutative property of addition (the order in which numbers are added does not affect the sum) • using the associative property of addition (grouping a set of numbers in different ways does not affect the sum) • explaining that the order in which numbers are subtracted may affect the difference. [C, CN, ME, PS, R, V]	**Specific Outcomes** 8. Apply estimation strategies to predict sums and differences of two 2-digit numerals in a problem-solving context. [C, ME, PS, R] 9. Demonstrate an understanding of addition and subtraction of numbers with answers to 1000 (limited to 1-, 2- and 3-digit numerals), concretely, pictorially and symbolically, by: • using personal strategies for adding and subtracting with and without the support of manipulatives • creating and solving problems in context that involve addition and subtraction of numbers. [C, CN, ME, PS, R, V]	**Specific Outcomes** 6. Demonstrate an understanding of multiplication (2- or 3-digit by 1-digit) to solve problems by: • using personal strategies for multiplication with and without concrete materials • using arrays to represent multiplication • connecting concrete representations to symbolic representations • estimating products • applying the distributive property. [C, CN, ME, PS, R, V] 7. Demonstrate an understanding of division (1-digit divisor and up to 2-digit dividend) to solve problems by: • using personal strategies for dividing with and without concrete materials • estimating quotients • relating division to multiplication. [C, CN, ME, PS, R, V]

Number (continued)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.		**General Outcome** Develop number sense.
Specific Outcomes 7. Demonstrate an understanding of fractions by using concrete, pictorial and symbolic representations to: • create sets of equivalent fractions • compare fractions with like and unlike denominators. [C, CN, PS, R, V] 8. Describe and represent decimals (tenths, hundredths, thousandths), concretely, pictorially and symbolically. [C, CN, R, V] 9. Relate decimals to fractions and fractions to decimals (to thousandths). [CN, R, V] 10. Compare and order decimals (to thousandths) by using: • benchmarks • place value • equivalent decimals. [C, CN, R, V]	**Specific Outcomes** 8. Demonstrate an understanding of multiplication and division of decimals (1-digit whole number multipliers and 1-digit natural number divisors). [C, CN, ME, PS, R, V] 9. Explain and apply the order of operations, excluding exponents, with and without technology (limited to whole numbers). [C, CN, ME, PS, T] [ICT: C6–2.4, C6–2.7]	**Specific Outcomes** 7. Compare and order positive fractions, positive decimals (to thousandths) and whole numbers by using: • benchmarks • place value • equivalent fractions and/or decimals. [CN, R, V]		**Specific Outcomes** 6. Determine an approximate square root of positive rational numbers that are non-perfect squares. [C, CN, PS, R, T] [ICT: P2–3.4]

Number (continued)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
	General Outcome Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.	**General Outcome** Develop number sense.
	Specific Outcomes 10. Describe and use mental mathematics strategies (memorization not intended), such as: • counting on and counting back • making 10 • using doubles • thinking addition for subtraction for basic addition facts and related subtraction facts to 18. [C, CN, ME, PS, R, V]	**Specific Outcomes** 10. Apply mental mathematics strategies, such as: • using doubles • making 10 • one more, one less • two more, two less • building on a known double • thinking addition for subtraction for basic addition facts and related subtraction facts to 18. [C, CN, ME, PS, R, V]	**Specific Outcomes** 10. Apply mental mathematics strategies and number properties, such as: • using doubles • making 10 • using the commutative property • using the property of zero • thinking addition for subtraction for basic addition facts and related subtraction facts to 18. [C, CN, ME, PS, R, V]	**Specific Outcomes** 8. Demonstrate an understanding of fractions less than or equal to one by using concrete, pictorial and symbolic representations to: • name and record fractions for the parts of a whole or a set • compare and order fractions • model and explain that for different wholes, two identical fractions may not represent the same quantity • provide examples of where fractions are used. [C, CN, PS, R, V] 9. Represent and describe decimals (tenths and hundredths), concretely, pictorially and symbolically. [C, CN, R, V]

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Develop number sense.				
Specific Outcomes 11. Demonstrate an understanding of addition and subtraction of decimals (limited to thousandths). [C, CN, PS, R, V]				

Number (continued)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
			General Outcome Develop number sense.	**General Outcome** Develop number sense.
			Specific Outcomes 11. Demonstrate an understanding of multiplication to 5 × 5 by: • representing and explaining multiplication using equal grouping and arrays • creating and solving problems in context that involve multiplication • modelling multiplication using concrete and visual representations, and recording the process symbolically • relating multiplication to repeated addition • relating multiplication to division. [C, CN, PS, R]	**Specific Outcomes** 10. Relate decimals to fractions and fractions to decimals (to hundredths). [C, CN, R, V] 11. Demonstrate an understanding of addition and subtraction of decimals (limited to hundredths) by: • using personal strategies to determine sums and differences • estimating sums and differences • using mental mathematics strategies to solve problems. [C, ME, PS, R, V]

Number (continued)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9

Number (continued)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
			General Outcome Develop number sense.	
			Specific Outcomes 12. Demonstrate an understanding of division (limited to division related to multiplication facts up to 5 × 5) by: • representing and explaining division using equal sharing and equal grouping • creating and solving problems in context that involve equal sharing and equal grouping • modelling equal sharing and equal grouping using concrete and visual representations, and recording the process symbolically • relating division to repeated subtraction • relating division to multiplication. [C, CN, PS, R]	

Number (continued)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9

Number (continued)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
			General Outcome Develop number sense.	
			Specific Outcomes 13. Demonstrate an understanding of fractions by: • explaining that a fraction represents a part of a whole • describing situations in which fractions are used • comparing fractions of the same whole that have like denominators. [C, CN, ME, R, V]	

Number (continued)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9

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

Patterns and Relations (Patterns)

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
General Outcome Use patterns to describe the world and to solve problems.	**General Outcome** Use patterns to describe the world and to solve problems.	**General Outcome** Use patterns to describe the world and to solve problems.	**General Outcome** Use patterns to describe the world and to solve problems.	**General Outcome** Use patterns to describe the world and to solve problems.
Specific Outcomes 1. Demonstrate an understanding of repeating patterns (two or three elements) by: • identifying • reproducing • extending • creating patterns using manipulatives, sounds and actions. [C, CN, PS, V] [ICT: P2–1.1] 2. Sort a set of objects based on a single attribute, and explain the sorting rule. [C, CN, PS, R, V]	**Specific Outcomes** 1. Demonstrate an understanding of repeating patterns (two to four elements) by: • describing • reproducing • extending • creating patterns using manipulatives, diagrams, sounds and actions. [C, PS, R, V] [ICT: P2–1.1] 2. Translate repeating patterns from one representation to another. [C, CN, R, V] 3. Sort objects, using one attribute, and explain the sorting rule. [C, CN, R, V]	**Specific Outcomes** 1. Demonstrate an understanding of repeating patterns (three to five elements) by: • describing • extending • comparing • creating patterns using manipulatives, diagrams, sounds and actions. [C, CN, PS, R, V] 2. Demonstrate an understanding of increasing patterns by: • describing • reproducing • extending • creating numerical (numbers to 100) and non-numerical patterns using manipulatives, diagrams, sounds and actions. [C, CN, PS, R, V] 3. Sort a set of objects, using two attributes, and explain the sorting rule. [C, CN, R, V]	**Specific Outcomes** 1. Demonstrate an understanding of increasing patterns by: • describing • extending • comparing • creating numerical (numbers to 1000) and non-numerical patterns using manipulatives, diagrams, sounds and actions. [C, CN, PS, R, V] 2. Demonstrate an understanding of decreasing patterns by: • describing • extending • comparing • creating numerical (numbers to 1000) and non-numerical patterns using manipulatives, diagrams, sounds and actions. [C, CN, PS, R, V] 3. Sort objects or numbers, using one or more than one attribute. [C, CN, R, V]	**Specific Outcomes** 1. Identify and describe patterns found in tables and charts. [C, CN, PS, V] [ICT: C6–2.3] 2. Translate among different representations of a pattern, such as a table, a chart or concrete materials. [C, CN, V] 3. Represent, describe and extend patterns and relationships, using charts and tables, to solve problems. [C, CN, PS, R, V] [ICT: C6–2.3] 4. Identify and explain mathematical relationships, using charts and diagrams, to solve problems. [CN, PS, R, V] [ICT: C6–2.3]

Patterns and Relations (Patterns)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Use patterns to describe the world and to solve problems.	**General Outcome** Use patterns to describe the world and to solve problems.	**General Outcome** Use patterns to describe the world and to solve problems.	**General Outcome** Use patterns to describe the world and to solve problems.	**General Outcome** Use patterns to describe the world and to solve problems.
Specific Outcomes 1. Determine the pattern rule to make predictions about subsequent elements. [C, CN, PS, R, V]	**Specific Outcomes** 1. Represent and describe patterns and relationships, using graphs and tables. [C, CN, ME, PS, R, V] [ICT: C6–2.3] 2. Demonstrate an understanding of the relationships within tables of values to solve problems. [C, CN, PS, R] [ICT: C6–2.3]	**Specific Outcomes** 1. Demonstrate an understanding of oral and written patterns and their equivalent linear relations. [C, CN, R] 2. Create a table of values from a linear relation, graph the table of values, and analyze the graph to draw conclusions and solve problems. [C, CN, PS, R, V] [ICT: C7–3.1]	**Specific Outcomes** 1. Graph and analyze two-variable linear relations. [C, ME, PS, R, T, V] [ICT: P2–3.3]	**Specific Outcomes** 1. Generalize a pattern arising from a problem-solving context, using a linear equation, and verify by substitution. [C, CN, PS, R, V] 2. Graph a linear relation, analyze the graph, and interpolate or extrapolate to solve problems. [C, CN, PS, R, T, V] [ICT: C7–3.1, P2–3.3]

Patterns and Relations (Variables and Equations)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
	General Outcome Represent algebraic expressions in multiple ways.	**General Outcome** Represent algebraic expressions in multiple ways.	**General Outcome** Represent algebraic expressions in multiple ways.	**General Outcome** Represent algebraic expressions in multiple ways.
	Specific Outcomes 4. Describe equality as a balance and inequality as an imbalance, concretely and pictorially (0 to 20). [C, CN, R, V] 5. Record equalities, using the equal symbol. [C, CN, PS, V]	**Specific Outcomes** 4. Demonstrate and explain the meaning of equality and inequality, concretely and pictorially. [C, CN, R, V] 5. Record equalities and inequalities symbolically, using the equal symbol or the not equal symbol. [C, CN, R, V]	**Specific Outcomes** 4. Solve one-step addition and subtraction equations involving a symbol to represent an unknown number. [C, CN, PS, R, V]	**Specific Outcomes** 5. Express a given problem as an equation in which a symbol is used to represent an unknown number. [CN, PS, R] 6. Solve one-step equations involving a symbol to represent an unknown number. [C, CN, PS, R, V]

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

Patterns and Relations (Variables and Equations)

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Represent algebraic expressions in multiple ways.	**General Outcome** Represent algebraic expressions in multiple ways.	**General Outcome** Represent algebraic expressions in multiple ways.	**General Outcome** Represent algebraic expressions in multiple ways.	**General Outcome** Represent algebraic expressions in multiple ways.
Specific Outcomes 2. Express a given problem as an equation in which a letter variable is used to represent an unknown number (limited to whole numbers). [C, CN, PS, R] 3. Solve problems involving single-variable, one-step equations with whole number coefficients and whole number solutions. [C, CN, PS, R]	**Specific Outcomes** 3. Represent generalizations arising from number relationships, using equations with letter variables. [C, CN, PS, R, V] 4. Express a given problem as an equation in which a letter variable is used to represent an unknown number. [C, CN, PS, R] 5. Demonstrate and explain the meaning of preservation of equality, concretely and pictorially. [C, CN, PS, R, V]	**Specific Outcomes** 3. Demonstrate an understanding of preservation of equality by: • modelling preservation of equality, concretely, pictorially and symbolically • applying preservation of equality to solve equations. [C, CN, PS, R, V] 4. Explain the difference between an expression and an equation. [C, CN] 5. Evaluate an expression, given the value of the variable(s). [CN, R] 6. Model and solve, concretely, pictorially and symbolically, problems that can be represented by one-step linear equations of the form $x + a = b$, where a and b are integers. [CN, PS, R, V]	**Specific Outcomes** 2. Model and solve problems concretely, pictorially and symbolically, using linear equations of the form: • $ax = b$ • $\frac{x}{a} = b,\ a \neq 0$ • $ax + b = c$ • $\frac{x}{a} + b = c,\ a \neq 0$ • $a(x + b) = c$ where a, b and c are integers. [C, CN, PS, V]	**Specific Outcomes** 3. Model and solve problems, using linear equations of the form: • $ax = b$ • $\frac{x}{a} = b,\ a \neq 0$ • $ax + b = c$ • $\frac{x}{a} + b = c,\ a \neq 0$ • $ax = b + cx$ • $a(x + b) = c$ • $ax + b = cx + d$ • $a(bx + c) = d(ex + f)$ • $\frac{a}{x} = b,\ x \neq 0$ where a, b, c, d, e and f are rational numbers. [C, CN, PS, V] 4. Explain and illustrate strategies to solve single variable linear inequalities with rational coefficients within a problem-solving context. [C, CN, PS, R, V]

Patterns and Relations (Variables and Equations) (continued)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4

Patterns and Relations (Variables and Equations) (continued)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
		General Outcome Represent algebraic expressions in multiple ways.		**General Outcome** Represent algebraic expressions in multiple ways.
		Specific Outcomes 7. Model and solve, concretely, pictorially and symbolically, problems that can be represented by linear equations of the form: • $ax + b = c$ • $ax = b$ • $\frac{x}{a} = b,\ a \neq 0$ where a, b and c are whole numbers. [CN, PS, R, V]		**Specific Outcomes** 5. Demonstrate an understanding of polynomials (limited to polynomials of degree less than or equal to 2). [C, CN, R, V] 6. Model, record and explain the operations of addition and subtraction of polynomial expressions, concretely, pictorially and symbolically (limited to polynomials of degree less than or equal to 2). [C, CN, PS, R, V] 7. Model, record and explain the operations of multiplication and division of polynomial expressions (limited to polynomials of degree less than or equal to 2) by monomials, concretely, pictorially and symbolically. [C, CN, R, V]

Shape and Space (Measurement)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
General Outcome Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.
Specific Outcomes 1. Use direct comparison to compare two objects based on a single attribute, such as length (height), mass (weight) and volume (capacity). [C, CN, PS, R, V]	**Specific Outcomes** 1. Demonstrate an understanding of measurement as a process of comparing by: • identifying attributes that can be compared • ordering objects • making statements of comparison • filling, covering or matching. [C, CN, PS, R, V]	**Specific Outcomes** 1. Relate the number of days to a week and the number of months to a year in a problem-solving context. [C, CN, PS, R] 2. Relate the size of a unit of measure to the number of units (limited to nonstandard units) used to measure length and mass (weight). [C, CN, ME, R, V] 3. Compare and order objects by length, height, distance around and mass (weight), using nonstandard units, and make statements of comparison. [C, CN, ME, R, V] 4. Measure length to the nearest nonstandard unit by: • using multiple copies of a unit • using a single copy of a unit (iteration process). [C, ME, R, V]	**Specific Outcomes** 1. Relate the passage of time to common activities, using nonstandard and standard units (minutes, hours, days, weeks, months, years). [CN, ME, R] 2. Relate the number of seconds to a minute, the number of minutes to an hour and the number of days to a month in a problem-solving context. [C, CN, PS, R, V] 3. Demonstrate an understanding of measuring length (cm, m) by: • selecting and justifying referents for the units cm and m • modelling and describing the relationship between the units cm and m • estimating length, using referents • measuring and recording length, width and height. [C, CN, ME, PS, R, V]	**Specific Outcomes** 1. Read and record time, using digital and analog clocks, including 24-hour clocks. [C, CN, V] 2. Read and record calendar dates in a variety of formats. [C, V] 3. Demonstrate an understanding of area of regular and irregular 2-D shapes by: • recognizing that area is measured in square units • selecting and justifying referents for the units cm^2 or m^2 • estimating area, using referents for cm^2 or m^2 • determining and recording area (cm^2 or m^2) • constructing different rectangles for a given area (cm^2 or m^2) in order to demonstrate that many different rectangles may have the same area. [C, CN, ME, PS, R, V]

Shape and Space (Measurement)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.
Specific Outcomes 1. Identify 90º angles. [ME, V] 2. Design and construct different rectangles, given either perimeter or area, or both (whole numbers), and make generalizations. [C, CN, PS, R, V] 3. Demonstrate an understanding of measuring length (mm) by: • selecting and justifying referents for the unit mm • modelling and describing the relationship between mm and cm units, and between mm and m units. [C, CN, ME, PS, R, V]	**Specific Outcomes** 1. Demonstrate an understanding of angles by: • identifying examples of angles in the environment • classifying angles according to their measure • estimating the measure of angles, using 45°, 90° and 180° as reference angles • determining angle measures in degrees • drawing and labelling angles when the measure is specified. [C, CN, ME, V] 2. Demonstrate that the sum of interior angles is: • 180° in a triangle • 360° in a quadrilateral. [C, R]	**Specific Outcomes** 1. Demonstrate an understanding of circles by: • describing the relationships among radius, diameter and circumference • relating circumference to pi • determining the sum of the central angles • constructing circles with a given radius or diameter • solving problems involving the radii, diameters and circumferences of circles. [C, CN, PS, R, V] 2. Develop and apply a formula for determining the area of: • triangles • parallelograms • circles. [CN, PS, R, V]	**Specific Outcomes** 1. Develop and apply the Pythagorean theorem to solve problems. [CN, PS, R, T, V] [ICT: P2–3.4] 2. Draw and construct nets for 3-D objects. [C, CN, PS, V] 3. Determine the surface area of: • right rectangular prisms • right triangular prisms • right cylinders to solve problems. [C, CN, PS, R, V] 4. Develop and apply formulas for determining the volume of right rectangular prisms, right triangular prisms and right cylinders. [C, CN, PS, R, V]	**Specific Outcomes** 1. Solve problems and justify the solution strategy, using the following circle properties: • the perpendicular from the centre of a circle to a chord bisects the chord • the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc • the inscribed angles subtended by the same arc are congruent • a tangent to a circle is perpendicular to the radius at the point of tangency. [C, CN, PS, R, T, V] [ICT: C6–3.1, C6–3.4]

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
		General Outcome Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.	
		Specific Outcomes 5. Demonstrate that changing the orientation of an object does not alter the measurements of its attributes. [C, R, V]	**Specific Outcomes** 4. Demonstrate an understanding of measuring mass (g, kg) by: • selecting and justifying referents for the units g and kg • modelling and describing the relationship between the units g and kg • estimating mass, using referents • measuring and recording mass. [C, CN, ME, PS, R, V] 5. Demonstrate an understanding of perimeter of regular and irregular shapes by: • estimating perimeter, using referents for cm or m • measuring and recording perimeter (cm, m) • constructing different shapes for a given perimeter (cm, m) to demonstrate that many shapes are possible for a perimeter. [C, ME, PS, R, V]	

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Use direct and indirect measurement to solve problems.	**General Outcome** Use direct and indirect measurement to solve problems.			
Specific Outcomes 4. Demonstrate an understanding of volume by: • selecting and justifying referents for cm^3 or m^3 units • estimating volume, using referents for cm^3 or m^3 • measuring and recording volume (cm^3 or m^3) • constructing right rectangular prisms for a given volume. [C, CN, ME, PS, R, V] 5. Demonstrate an understanding of capacity by: • describing the relationship between mL and L • selecting and justifying referents for mL or L units • estimating capacity, using referents for mL or L • measuring and recording capacity (mL or L). [C, CN, ME, PS, R, V]	**Specific Outcomes** 3. Develop and apply a formula for determining the: • perimeter of polygons • area of rectangles • volume of right rectangular prisms. [C, CN, PS, R, V]			

Shape and Space (3-D Objects and 2-D Shapes)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
General Outcome Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	**General Outcome** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	**General Outcome** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	**General Outcome** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	**General Outcome** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.
Specific Outcomes 2. Sort 3-D objects, using a single attribute. [C, CN, PS, R, V] 3. Build and describe 3-D objects. [CN, PS, V]	**Specific Outcomes** 2. Sort 3-D objects and 2-D shapes, using one attribute, and explain the sorting rule. [C, CN, R, V] 3. Replicate composite 2-D shapes and 3-D objects. [CN, PS, V] 4. Compare 2-D shapes to parts of 3-D objects in the environment. [C, CN, V]	**Specific Outcomes** 6. Sort 2-D shapes and 3-D objects, using two attributes, and explain the sorting rule. [C, CN, R, V] 7. Describe, compare and construct 3-D objects, including: • cubes • spheres • cones • cylinders • pyramids. [C, CN, R, V] 8. Describe, compare and construct 2-D shapes, including: • triangles • squares • rectangles • circles. [C, CN, R, V] 9. Identify 2-D shapes as parts of 3-D objects in the environment. [C, CN, R, V]	**Specific Outcomes** 6. Describe 3-D objects according to the shape of the faces and the number of edges and vertices. [C, CN, PS, R, V] 7. Sort regular and irregular polygons, including: • triangles • quadrilaterals • pentagons • hexagons • octagons according to the number of sides. [C, CN, R, V]	**Specific Outcomes** 4. Describe and construct right rectangular and right triangular prisms. [C, CN, R, V]

Shape and Space (3-D Objects and 2-D Shapes)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	**General Outcome** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	**General Outcome** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	**General Outcome** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	**General Outcome** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.
Specific Outcomes 6. Describe and provide examples of edges and faces of 3-D objects, and sides of 2-D shapes that are: • parallel • intersecting • perpendicular • vertical • horizontal. [C, CN, R, T, V] [ICT: C6–2.2, P5–2.3] 7. Identify and sort quadrilaterals, including: • rectangles • squares • trapezoids • parallelograms • rhombuses according to their attributes. [C, R, V]	**Specific Outcomes** 4. Construct and compare triangles, including: • scalene • isosceles • equilateral • right • obtuse • acute in different orientations. [C, PS, R, V] 5. Describe and compare the sides and angles of regular and irregular polygons. [C, PS, R, V]	**Specific Outcomes** 3. Perform geometric constructions, including: • perpendicular line segments • parallel line segments • perpendicular bisectors • angle bisectors. [CN, R, V]	**Specific Outcomes** 5. Draw and interpret top, front and side views of 3-D objects composed of right rectangular prisms. [C, CN, R, T, V] [ICT: C6–3.4]	**Specific Outcomes** 2. Determine the surface area of composite 3-D objects to solve problems. [C, CN, PS, R, V] 3. Demonstrate an understanding of similarity of polygons. [C, CN, PS, R, V]

Shape and Space (Transformations)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
				General Outcome Describe and analyze position and motion of objects and shapes.
				Specific Outcomes 5. Demonstrate an understanding of congruency, concretely and pictorially. [CN, R, V] 6. Demonstrate an understanding of line symmetry by: • identifying symmetrical 2-D shapes • creating symmetrical 2-D shapes • drawing one or more lines of symmetry in a 2-D shape. [C, CN, V]

Shape and Space (Transformations)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Describe and analyze position and motion of objects and shapes.	**General Outcome** Describe and analyze position and motion of objects and shapes.	**General Outcome** Describe and analyze position and motion of objects and shapes.	**General Outcome** Describe and analyze position and motion of objects and shapes.	**General Outcome** Describe and analyze position and motion of objects and shapes.
Specific Outcomes 8. Identify and describe a single transformation, including a translation, rotation and reflection of 2-D shapes. [C, T, V] [ICT: C6–2.1] 9. Perform, concretely, a single transformation (translation, rotation or reflection) of a 2-D shape, and draw the image. [C, CN, T, V] [ICT: C6–2.1]	**Specific Outcomes** 6. Perform a combination of translations, rotations and/or reflections on a single 2-D shape, with and without technology, and draw and describe the image. [C, CN, PS, T, V] 7. Perform a combination of successive transformations of 2-D shapes to create a design, and identify and describe the transformations. [C, CN, T, V] 8. Identify and plot points in the first quadrant of a Cartesian plane, using whole number ordered pairs. [C, CN, V] 9. Perform and describe single transformations of a 2-D shape in the first quadrant of a Cartesian plane (limited to whole number vertices). [C, CN, PS, T, V] [ICT: C6–2.1]	**Specific Outcomes** 4. Identify and plot points in the four quadrants of a Cartesian plane, using integral ordered pairs. [C, CN, V] 5. Perform and describe transformations (translations, rotations or reflections) of a 2-D shape in all four quadrants of a Cartesian plane (limited to integral number vertices). [C, CN, PS, T, V] [ICT: C6–3.4]	**Specific Outcomes** 6. Demonstrate an understanding of the congruence of polygons. [CN, R, V]	**Specific Outcomes** 4. Draw and interpret scale diagrams of 2-D shapes. [CN, R, T, V] [ICT: C6–3.4] 5. Demonstrate an understanding of line and rotation symmetry. [C, CN, PS, V]

Statistics and Probability (Data Analysis)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
		General Outcome Collect, display and analyze data to solve problems.	**General Outcome** Collect, display and analyze data to solve problems.	**General Outcome** Collect, display and analyze data to solve problems.
		Specific Outcomes 1. Gather and record data about self and others to answer questions. [C, CN, PS, V] [ICT: C4–1.3, C7–1.1] 2. Construct and interpret concrete graphs and pictographs to solve problems. [C, CN, PS, R, V] [ICT: C7–1.3]	**Specific Outcomes** 1. Collect first-hand data and organize it using: • tally marks • line plots • charts • lists to answer questions. [C, CN, PS, V] [ICT: C4–1.3] 2. Construct, label and interpret bar graphs to solve problems. [C, PS, R, V] [ICT: C4–1.3, C7–1.3, C7–1.4]	**Specific Outcomes** 1. Demonstrate an understanding of many-to-one correspondence. [C, R, T, V] [ICT: C6–2.2, C6–2.3] 2. Construct and interpret pictographs and bar graphs involving many-to-one correspondence to draw conclusions. [C, PS, R, V]

Statistics and Probability (Data Analysis)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
General Outcome Collect, display and analyze data to solve problems.	**General Outcome** Collect, display and analyze data to solve problems.	**General Outcome** Collect, display and analyze data to solve problems.	**General Outcome** Collect, display and analyze data to solve problems.	**General Outcome** Collect, display and analyze data to solve problems.
Specific Outcomes 1. Differentiate between first-hand and second-hand data. [C, R, T, V] [ICT: C1–2.2, P5–2.3] 2. Construct and interpret double bar graphs to draw conclusions. [C, PS, R, T, V] [ICT: C6–2.2, P5–2.3]	**Specific Outcomes** 1. Create, label and interpret line graphs to draw conclusions. [C, CN, PS, R, V] 2. Select, justify and use appropriate methods of collecting data, including: • questionnaires • experiments • databases • electronic media. [C, CN, PS, R, T] [ICT: C4–2.2, C6–2.2, C7–2.1, P2–2.1, P2–2.2] 3. Graph collected data, and analyze the graph to solve problems. [C, CN, PS, R, T] [ICT: C6–2.5, C7–2.1, P2–2.1, P2–2.2]	**Specific Outcomes** 1. Demonstrate an understanding of central tendency and range by: • determining the measures of central tendency (mean, median, mode) and range • determining the most appropriate measures of central tendency to report findings. [C, PS, R, T] [ICT: P2–3.4] 2. Determine the effect on the mean, median and mode when an outlier is included in a data set. [C, CN, PS, R] 3. Construct, label and interpret circle graphs to solve problems. [C, CN, PS, R, T, V] [ICT: P2–3.3]	**Specific Outcomes** 1. Critique ways in which data is presented in circle graphs, line graphs, bar graphs and pictographs. [C, R, T, V] [ICT: C7–3.1, C7–3.2, F4–3.3]	**Specific Outcomes** 1. Describe the effect of: • bias • use of language • ethics • cost • time and timing • privacy • cultural sensitivity on the collection of data. [C, CN, R, T] [ICT: F4–3.2, F4–3.3] 2. Select and defend the choice of using either a population or a sample of a population to answer a question. [C, CN, PS, R]

Statistics and Probability (Data Analysis) (continued)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4

Statistics and Probability (Data Analysis) (continued)

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

Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
				General Outcome Collect, display and analyze data to solve problems.
				Specific Outcomes 3. Develop and implement a project plan for the collection, display and analysis of data by: • formulating a question for investigation • choosing a data collection method that includes social considerations • selecting a population or a sample • collecting the data • displaying the collected data in an appropriate manner • drawing conclusions to answer the question. [C, PS, R, T, V] [ICT: C1–3.5, C4–3.1, C6–3.1, C6–3.2, C7–3.1, C7–3.2, P1–3.4, P2–3.1]

Statistics and Probability (Chance and Uncertainty)

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

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4

Statistics and Probability (Chance and Uncertainty)

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

<table>
<tr><th>Grade 5</th><th>Grade 6</th><th>Grade 7</th><th>Grade 8</th><th>Grade 9</th></tr>
<tr><td>General Outcome
Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.</td><td>General Outcome
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Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.</td></tr>
<tr><td>Specific Outcomes

3. Describe the likelihood of a single outcome occurring, using words such as:
• impossible
• possible
• certain.
[C, CN, PS, R]

4. Compare the likelihood of two possible outcomes occurring, using words such as:
• less likely
• equally likely
• more likely.
[C, CN, PS, R]</td><td>Specific Outcomes

4. Demonstrate an understanding of probability by:
• identifying all possible outcomes of a probability experiment
• differentiating between experimental and theoretical probability
• determining the theoretical probability of outcomes in a probability experiment
• determining the experimental probability of outcomes in a probability experiment
• comparing experimental results with the theoretical probability for an experiment.
[C, ME, PS, T]
[ICT: C6–2.1, C6–2.4]</td><td>Specific Outcomes

4. Express probabilities as ratios, fractions and percents.
[C, CN, R, T, V]
[ICT: P2–3.4]

5. Identify the sample space (where the combined sample space has 36 or fewer elements) for a probability experiment involving two independent events.
[C, ME, PS]

6. Conduct a probability experiment to compare the theoretical probability (determined using a tree diagram, table or other graphic organizer) and experimental probability of two independent events.
[C, PS, R, T]
[ICT: C7–3.2, P2–3.4]</td><td>Specific Outcomes

2. Solve problems involving the probability of independent events.
[C, CN, PS, T]
[ICT: P2–3.4]</td><td>Specific Outcomes

4. Demonstrate an understanding of the role of probability in society.
[C, CN, R, T]
[ICT: F4–3.3]</td></tr>
</table>