Saskatchewan Learning

Kindergarten Mathematics Curriculum

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- other field personnel.

This curriculum in based on the Western and Northern Canadian Protocol (WNCP) Common Curriculum Framework (CCF) (2006) for Kindergarten to Grade 9 Mathematics.

This document was completed under the direction of the Science and Technology Unit, Curriculum and E-Learning Branch, and the French Education Branch of Saskatchewan Learning. A feedback form is included at the end of this document to provide Saskatchewan Learning with your ideas and comments related to this curriculum.

Kindergarten Mathematics

Purpose

The Kindergarten Mathematics Curriculum defines the outcomes to be attained by Kindergarten students. It is designed to support teachers in providing students with learning opportunities to develop appropriate mathematics knowledge, understandings, and abilities within a learning environment that supports the students' development of positive attitudes and beliefs towards mathematics. Indicators are included for each outcome to clarify the breadth and depth of learning intended by the outcome. These indicators are a representative list of the kinds of things a student needs to know and/or be able to do in order to achieve the learnings intended by the outcome.

Outcomes are statements identifying what students are expected to know, understand, and be able to do by the end of a particular grade level.

This curriculum also provides information for teachers to understand how the outcomes of the Kindergarten Mathematics Curriculum connect to the K-12 Goals for mathematics, the Cross-curricular Competencies to be addressed in all areas of study, and the Broad Areas of Learning that summarize the Goals of Education for Saskatchewan students.

Indicators are a representative list of things students could be asked to know or do in order to show their attainment of the outcome. The indicators are intended to clarify the breadth and depth of the outcome.

Appendix A provides explanations of some of the mathematical terminology you will find in this curriculum. Appendix B: Two Grades at a Glance has been included to help teachers see how the kindergarten outcomes are related to the Grade 1 outcomes.

An introduction to pedagogical understandings necessary for the effective teaching of mathematics is included. Additional support resources that explore and demonstrate these pedagogical understandings will be provided online.

This curriculum has been designed to address current research in mathematics education as well as to address the learning needs of young children. Changes to the outcomes in all the grades of mathematics K to 12 have been made for a number of reasons including:

- decreasing content in each grade to allow for more depth of understanding
- rearranging concepts to allow for greater depth of learning in one year and to align related mathematical concepts
- increasing the focus on numeracy (understanding numbers) beginning in Kindergarten
- introducing algebraic thinking earlier.

Aim and Goals of K-12 Mathematics

When we ask good questions in math class, we invite our students to think, to understand, and to share a mathematical journey with their classmates and teachers alike. Students are no longer passive receivers of information when asked questions that challenge their understandings and convictions about mathematics. (Sullivan, 2002, p. 1)

The aim of the mathematics program is to prepare individuals who value mathematics and appreciate its role in society. The K-12 mathematics curricula are designed to prepare students to cope confidently and competently with everyday situations that demand the use of mathematical concepts including interpreting quantitative information, estimating, performing calculations mentally, measuring, understanding spatial relationships, and problem solving. The mathematics program is intended to stimulate the spirit of inquiry within the context of mathematical thinking and reasoning.

The four goals for K-12 mathematics are broad statements that identify the knowledge, understandings, skills, and attitudes in mathematics that students are expected to develop and demonstrate by the end of grade twelve. Within each grade level, outcomes are directly related to the development of one or more of these goals. The goals for K-12 mathematics are:

Logical Thinking: *Develop and be able to apply mathematical reasoning processes, skills, and strategies to new situations and problems.*

This goal encompasses the processes and strategies that are foundational to understanding mathematics as a discipline. These processes and strategies include:

- inductive and deductive thinking
- abstracting and generalizing
- exploring, identifying, and describing patterns
- verifying and proofing
- exploring, identifying, and describing relationships
- modeling and representing (concretely, visually, physically, and symbolically)
- hypothesizing and asking "what if" (mathematical play).

Number Sense: *Develop an understanding of the meaning of, relationships between, properties of, roles of, and representations (including symbolic) of numbers and apply this understanding to new situations and problems.*

Key to developing number sense is students having ongoing experience with:

- decomposing and composing of numbers
- relating different operations to each other
- modeling and representing numbers and operations (concretely, visually, physically, and symbolically)

- understanding the origins and need for different types of numbers
- recognizing operations on different number types as being the same operations
- understanding equality and inequality
- recognizing the variety of roles for numbers
- understanding algebraic representations and manipulations in terms of extending numbers
- looking for patterns and ways to describe those patterns numerically and algebraically.

Spatial Sense: *Develop an understanding of 2-D shapes and 3-D objects and the relationships between geometrical shapes and objects, and numbers and apply this understanding to new situations and problems.*

Development of a strong spatial sense requires students to experience:
- construction and deconstruction of 2-D shapes and 3-D objects
- investigations into relationships between 2-D shapes and 3-D objects
- explorations of how number (and algebra) can be used to describe 2-D shapes and 3-D objects
- exploration of the movement of 2-D shapes and 3-D objects
- exploration of the dimensions of 2-D shapes and 3-D objects
- exploration of different forms of measurement and their meaning.

Mathematical Attitude: *Develop a positive attitude towards the ability to understand mathematics and to use it to solve problems.*

Mathematical ability and confidence is built through playing with numbers and related concepts in a supportive environment. Students can persevere when challenged if provided with opportunities to learn mathematics within an environment that:
- supports risk taking (mathematically and personally)
- honours students' ideas
- provides engaging and responsive learning experiences.

Students who have a positive attitude towards mathematics demonstrate:
- confidence in their mathematical insights and abilities
- enjoyment, curiousity, and perseverance when encountering new problems
- appreciation of the structure and value of mathematics.

There are many "real-world" applications of the mathematics within the K-12 Mathematics curricula. The curriculum content first and

Math makes sense! This is the most fundamental idea that an elementary teacher of mathematics needs to believe and act on. It is through the teacher's actions that every child in his or her own way can come to believe this simple truth and, more importantly, believe that he or she is capable of making sense of mathematics. (Van de Walle & Lovin, 2006, p. ix)

foremost serves as the vehicle through which students can achieve the four goals of K-12 mathematics in Saskatchewan. Mathematically confident students apply mathematical knowledge to new situations and to solve problems.

Connections to Broad Areas of Learning

There are three Broad Areas of Learning that reflect Saskatchewan's Goals of Education.

Building a Disposition for Learning

Mathematics enables individuals to understand and explore the world, and communicate and participate in a variety of roles and settings in the home, school, and community.

Students engaged in constructing and applying mathematical knowledge in an authentic learning environment, which includes a variety of experiences and contexts, build a positive disposition for learning. In mathematics, an environment that supports risk taking allows students to learn from errors and to appreciate the value of errors in learning. In such an environment, students manipulate objects and ideas, value multiple ways of arriving at a solution, build confidence, and develop perseverance. When actively exploring mathematical content through inquiry in an appropriate environment, students develop mathematical reasoning, number sense, spatial sense, and a positive attitude towards mathematics.

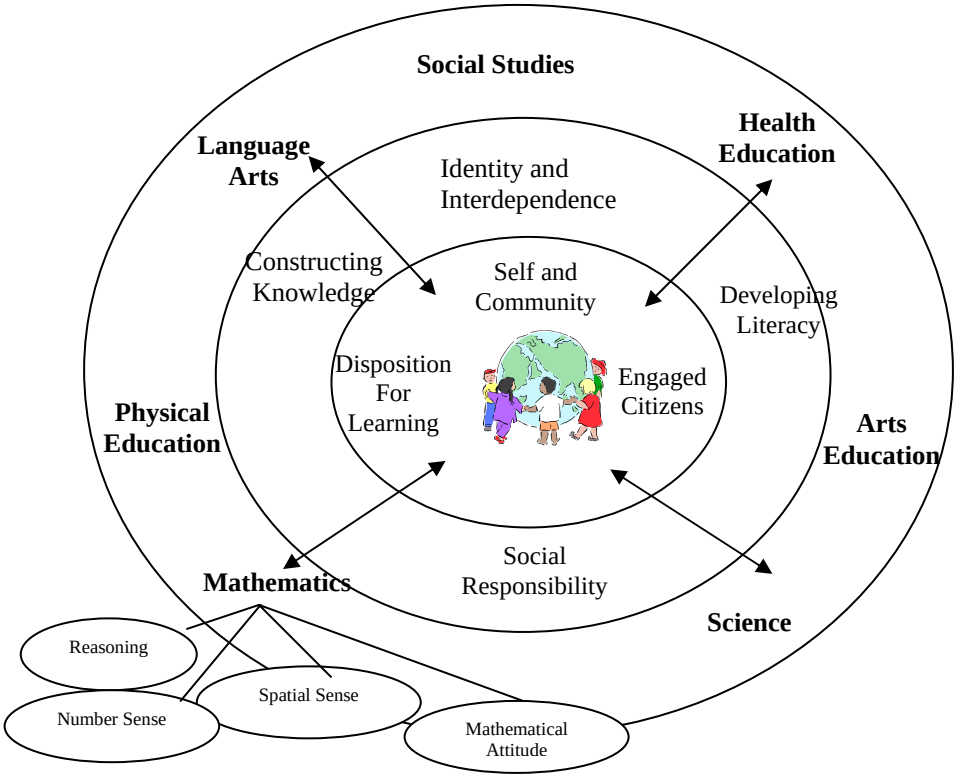
Building a Sense of Self and Community

Exploring mathematics in a collaborative learning environment, rich in dialogue, provides opportunities for students to strengthen connections with others. When students work together to explore, negotiate, reflect, and construct personal strategies, students achieve a deeper understanding of mathematics. As well, students experience different points of view and learn to value diversity of perspectives and ways of knowing. In such an environment, students learn and come to value personal understandings, accomplishments, and contributions. As a member of a group, each student contributes to the learning community and social climate of the classroom.

Building Engaged Citizens

Co-planning the learning environment empowers students to communicate and make decisions about learning. It also enables students to contribute to the social harmony of the learning community. Mathematical exploration and analysis brings a unique perspective and way of learning to view and construct one's understanding of the world through a mathematical lens. Such processes also help students develop a greater respect for and

understanding of how different points of views and options can strengthen thinking and potential options. Students become engaged citizens, who solve problems and make personal decisions regarding their roles and contributions to the world.



Connections to Cross-curricular Competencies

There are four cross-curricular competencies that together contribute to an individual student's development within the four Broad Areas of Learning. These competencies are synthesized from the Common Essential Learnings. It is important, therefore, that the learning of mathematics also supports the students in their attainment of these competencies.

Constructing Knowledge

Constructing knowledge is how people make sense of the world around them.

Students construct meaning of mathematical language and concepts when engaged in an inquiry-based and problem-solving environment that provides opportunities to think critically and creatively. Moreover, students gain a deeper understanding of mathematics when actively exploring and applying mathematics in relevant and varied

contexts. Mathematics enables students to consider different perspectives, connections, and relationships in the world.

Identity and Interdependence

We want students to develop a positive self-concept and to have the ability to live in harmony with others, and with the natural and constructed world.

Students become confident in mathematics when supported in taking risks in an accepting and respectful environment that promotes self-reflection. When interacting with others to explore and solve problems, students discuss and negotiate strategies and solutions. Students learn to contribute, to respect each other's ideas, and to act responsibly. A purposeful approach to learning mathematics allows students to appreciate their role in the planning, organizing, and management of the learning environment.

Developing Literacy

Students develop mathematical literacy by representing their environment through words, numbers, music, and drama. Students explore and use a variety of representations for mathematical concepts. Using auditory, visual, and symbolic representations as well as concrete manipulatives and physical movement, deepens students' understanding of mathematics and allows them to communicate understandings.

Social Responsibility

When engaged in the co-construction of mathematical knowledge, students are respectful when understanding and considering others' ideas, perspectives, suggestions, and contributions. Students become aware of the possibility of more than one solution to a problem or situation, and they learn to work with others to negotiate solutions to problems in the school, the community, and the world. When working in a group exploring mathematical problems, students learn to negotiate to resolve conflicts.

Curriculum Integration

Young students arrive at school with a natural curiosity. An engaging learning environment provides opportunities to satisfy and nourish this curiosity or thirst for knowledge. When exploring mathamatics in such an environment, students make connections within mathematics, with other curricular areas, and with the world. Experiencing mathematical concepts in rich contexts allows students to transfer knowledge and understanding to new situations. Some examples of integrating mathematics with other areas of study are described below.

When students experience mathematics as a lens through which to view other subjects, and other subjects as lenses through which to view mathematics, students learn that mathematics is much more than a set of facts and procedures to memorize.

Arts Education – In Kindergarten, Arts Education has a focus on the students' environment and interests. The mathematics they are learning should also be embedded in such contexts. The arts education program provides many avenues through which students can be engaged in exploring different ways to make sense of and represent their mathematical understandings. All four of the strands in Arts Education can be incorporated into the students' mathematical learning experiences and vice versa.

English Language Arts – Numbers are an inherently abstract concept, so it is important to embed student learning about number into meaningful contexts. The use of story as a context for the students learning the number names, number sequence, numerals, and how to determine quantity is essential in Kindergarten to provide students with concrete ways of understanding. Stories also help students develop their understanding of patterns and shapes. In Kindergarten, there are many opportunities to integrate the students' mathematical learnings with their exploration of all six strands in English language arts.

Numbers are an inherently abstract concept, so it is important to embed student learning about number into meaningful contexts.

Health Education – In Kindergarten, health education focuses on providing opportunities for students to attain and maintain a healthy mind, body, and spirit. A school-based health education program is essential for Kindergarten students to begin to understand how their decisions can impact their health and well-being. Although most of their environment and daily living activities are beyond their control, Kindergarten students learn to choose behaviours that contribute positively to their health and well-being. In mathematics, the students should be actively engaged in their learning, providing many opportunities for students and teachers to explore and develop the students' understanding of how their decisions and behaviours impact the students' health and well being.

Physical Education – In Kindergarten, students are exploring and improving their locomotor, non-locomotor, and manipulative skills in physical education. These experiences can be connected to the development of the students' mathematical understandings by relating their movement to counting, patterning, and arranging of movements.

Science – In science, students are exploring their environment with their senses. Students' mathematical learnings can thus be integrated with scientific inquiries by asking the students related counting and patterning questions. As well, the students can identify and describe different 3-D objects within the environment using the different senses as a way of creating a deeper understanding of 3-D objects and their characteristics.

Social Studies – Understandings of what it means to be together as a group, to be an individual, and to share stories with a group that are developed in social studies should also be emphasized in the students' study of mathematics. The mathematics classroom environment should encourage both the interaction of the students, including the sharing of their thoughts and knowledge, and the valuing of the individual. Thus, the mathematics classroom becomes a context in which the students' learnings from social studies can be enacted.

Critical Characteristics of Mathematics Education

The content of K-12 Mathematics can be organized in a variety of ways. In this document, the outcomes and indicators are grouped according to four strands: **Number, Patterns and Relations, Shape and Space, and Statistics and Probability.** Although this organization implies a relation between the outcomes identified in each of the strands, it should be noted the mathematical concepts are interrelated between strands as well as within strands.

Mathematical concepts are interrelated between strands as well as within strands.

The mathematics curriculum also recognizes seven processes inherent in the teaching, learning, and doing of mathematics. These processes focus on: communicating, making connections, mental mathematics and estimating, problem solving, reasoning, and visualizing along with using technology to integrate these processes into the mathematics classroom to help students learn mathematics with deeper understanding.

When mathematics is taught without a rich integration of these processes, it becomes a stagnant set of facts and procedures devoid of meaning rather than the dynamic and rich discipline that it is.

The outcomes in K-12 mathematics should be addressed through the appropriate mathematical processes lenses. Teachers should consider carefully in their planning those processes indicated as being important to the various outcomes.

Communication [C]

Students need opportunities to view, "read" about, represent, 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 learning using mathematical terminology.

Communication can help students make connections among concrete, pictorial, symbolic, verbal, written, and mental representations of mathematical ideas.

Connections [CN]

Through connections to their prior knowledge and daily life, 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. 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 are fundamental components of number sense.

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

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)

Estimation is a strategy for determining approximate values of quantities, usually by referring to benchmarks or using referents, or for determining the reasonableness of calculated values. Students need to know how, when, and what strategy to use when estimating.

Estimation is used to make mathematical judgements and develop 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 being open to listening, discussing, and trying different strategies.

In order for an activity to be problem-solving based, it must ask students to determine a way to get from what is known to what is sought. If students have already been given ways to solve the problem, it is not problem solving, but rote 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.

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

Problem solving is a powerful teaching tool that fosters multiple and creative 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 confidence, reasoning, and mathematical creativity.

Reasoning [R]

Mathematical reasoning helps students think logically and make sense of mathematics. Students need to develop confidence in their abilities to reason and explain 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 inductive and deductive reasoning. Inductive reasoning occurs when students explore and record results, analyze observations, make generalizations from patterns, and test these generalizations. Deductive reasoning occurs when students reach new conclusions based upon what is already known or assumed to be true.

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.

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

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 [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.

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 and test properties
- develop personal procedures for mathematical operations
- create geometric displays
- 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. It is important for students to understand and appreciate the appropriate use of technology in a mathematics classroom.

Teaching for Deep Understanding

For deep understanding, it is vital that students learn by uncovering and co-constructing knowledge, with very few ideas being covered or relayed directly by the teacher. As an example, the addition sign (+) is something which the teacher must cover and teach. It is the symbol used to show the combination or addition of two quantities. The process of adding, however, and the development of addition and subtraction facts should not be covered, but rather *discovered* through the students' investigation of patterns, relationships, abstractions, and generalizations. It is important for teachers to reflect upon outcomes to identify what students need to know, understand, and be able to do. Opportunities must be provided for students to explain, apply and transfer understanding to new situations. This reflection supports professional decision making and planning effective strategies to promote deeper understanding of mathematical ideas.

It is important that a mathematics learning environment include effective interplay of:

- reflection
- exploration of patterns and relationships
- sharing of ideas and problems
- consideration of different perspectives
- decision making
- generalizing
- verifying and proving
- modeling and representing.

Mathematics is learned when students are engaged in strategic play with mathematical concepts and differing perspectives. When students learn mathematics by being told what to do, how to do it, and when to do it, they cannot make the strong learning connections necessary for learning to be meaningful, easily accessible, and transferable.

The mathematics learning environment must be respectful of individuals and groups, fostering discussion and self-reflection, the asking of questions, the seeking of multiple answers, and the co-construction of meaning.

In Kindergarten, teaching for deep understanding will be successful if all learning occurs in meaningful contexts. Students need to have reasons to want and need to know the whole number sequence. Otherwise, the whole number sequence becomes a memorized fact that is not associated with any meaning. Then when students learn about counting, they fail to realize what the role of that number sequence is. Thus, the use of stories, explorations, and discussions that the students bring forward as being of interest must be a foundation of the Kindergarten mathematics classroom. It is within these contexts that students will realize a need for numbers, and in turn will learn the whole number sequence from 0 to 10, as well as how these numbers are related to determining quantity, or how many.

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

Kindergarten Mathematics Outcomes and Indicators

Number Strand		
Goals	**Outcomes** *Students will:*	**Indicators** *(The following indicators **may** be used to determine whether students have met the corresponding outcome.)*
Number Sense *Mathematical Attitude*	NK.1 Say the whole number sequence by 1s starting anywhere from 0 to 10 and from 10 to 0. [C, CN, V]	a) State the whole number that comes after a given number, zero to nine. b) State the whole number that comes before a given number, one to ten. c) Recite the whole number names from a given number to a stated number (forward – zero to ten, backward – ten to zero) using visual aids.
Number Sense *Spatial Sense*	NK.2 Recognize, at a glance, and name familiar arrangements of 1 to 5 objects, dots, or pictures. C, CN, ME, V]	a) Look briefly at a given familiar arrangement of 1 to 5 objects or dots, and identify the whole number that represents the number of objects or dots without counting. b) Identify the whole number that represents an arrangement of objects, dots, or pictures on a five frame.
Number Sense *Mathematical Attitude*	NK.3 Relate a numeral, 0 to 10, to its respective quantity. [C, R, V]	a) Construct or draw a set of objects corresponding to a given numeral. b) Identify the number of objects in a set. c) Hold up the appropriate number of fingers for a given numeral. d) Match numerals with pictorial representations.
Number Sense *Spatial Sense* *Logical Thinking* *Mathematical Attitude*	NK.4 Represent the partitioning of whole numbers (1 to 10) concretely and pictorially. [C, CN, ME, R, V]	a) Show a whole number in two parts, using fingers, counters or other objects and name the number of objects in each part. b) Show a whole number in two parts, using pictures, and name the number of objects in each part.

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

Number Strand		
Goals	**Outcomes** *Students will:*	**Indicators** *(The following indicators **may** be used to determine whether students have met the corresponding outcome.)*
Number Sense *Logical Thinking* *Mathematical Attitude*	NK.5 Compare quantities, 0 to 10, using one-to-one correspondence. [C, CN, V]	a) Construct a set to show more than, fewer than, or as many objects as in a given set of objects. b) Compare two sets through direct comparison, and describe the relationship between the sets using words such as: more, fewer, as many as, or the same number.

Patterns and Relations Strand		
Goals	**Outcomes** *Students will:*	**Indicators** *(The following indicators **may** be used to determine whether students have met the corresponding outcome.)*
Logical Thinking *Mathematical Attitude* *Spatial Sense*	PK.1 Demonstrate an understanding of repeating pattern (two or three elements) by: • identifying • reproducing • extending • creating patterns using manipulatives, sounds, and actions. [C, CN, PS, V]	a) Distinguish between repeating patterns and non-repeating sequences by identifying the part that repeats. b) Copy a repeating pattern (e.g., actions, sound, colour, size, shape, or orientation) and describe the pattern. c) Extend repeating patterns by two more repetitions. d) Create a repeating pattern, using manipulatives, musical instruments, or actions and describe the pattern. e) Identify and describe a repeating pattern in the classroom, the school, and outdoors (e.g., in a familiar song, in a nursery rhyme, in a game, on the street, on the playground).

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

Shape and Space Strand		
Goals	**Outcomes** *Students will:*	**Indicators** *(The following indicators **may** be used to determine whether students have met the corresponding outcome.)*
Spatial Sense *Mathematical Attitude* *Logical Thinking*	SSK.1 Use direct comparison to compare two objects based on a single attribute, such as • length including height • mass • volume • capacity. [C, CN, PS, R, V]	a) Compare the length or height of two objects and explain how they compare using the words shorter, longer, taller, or almost the same. b) Compare the mass of two objects and explain how they compare using the words lighter, heavier, or almost the same. c) Compare the volume of two objects or capacity of two containers and explain how they compare using the words less, more, bigger, smaller, or almost the same.
Spatial Sense *Logical Thinking* *Mathematical Attitude*	SSK.2 Sort 3-D objects using a single attribute. [C, CN, PS, R, V]	a) Sort a set of familiar 3-D objects using a single attribute, such as size or shape, and explain the sorting rule. b) Determine the difference between two pre-sorted sets by identifying the sorting rule used to sort each of them.
Spatial Sense *Mathematical Attitude* *Logical Thinking*	SSK.3 Build and describe 3-D objects. [C, PS, V]	a) Create a representation of a 3-D object using materials such as modelling clay and building blocks, and compare the representation to the original 3-D object. b) Describe a 3-D object using words such as big, little, round, like a box, and like a can.

Appendix A: Terminology

Benchmarks: Numeric quantities used to compare and order other numeric quantities.

Carroll Diagram: A table used for organizing and highlighting relationships between characteristics of elements in a data set. Each characteristic is broken into a yes/no descriptors or into independent categories. The Carroll diagram shows all possible ways to match the different categories between the characteristics. For example, the following Carroll diagram represents information about a classroom in terms of girls and boys with shoes or sandals:

	Boy	Girl
Shoes	7	3
Sandals	2	4

These diagrams can be used to analyze a situation according to one characteristic, one category, or a combination of both.

Front-end Estimation: A process of finding approximate values for computations by considering rounded or sometimes truncated values (e.g., 34 + 72 is approximately equal to 30 + 70 = 100 by front-end estimation).

Graphic Organizer: Any visual representation used to show relationships between data, information, and/or understandings. Some examples are Venn diagrams, tree diagrams, concept webs, and Carroll diagrams.

Independent Events: Two or more occurrences of an event that do not influence each other.

Outlier: A piece of data that lies outside of the normal dispersion of the data in the set.

Preservation of Equality: A mathematical concept that allows for manipulation and alternate representations by ensuring that the new expression and/or equation meaning is maintained. In expressions, preservation of equality involves the application of an operation and its inverse to the expression (e.g., adding 3 and subtracting 3 or multiplying by 2 and dividing by 2 preserves equality). In equations, equality can be preserved by applying an operation and its inverse to one side of the equation (each of which is an expression), or by applying the same operation to both sides of the equation.

Record the Process Symbolically: It is important that as students explore and represent mathematical concepts concretely, physically, and visually that at each stage students be required to reflect upon what it would look like symbolically. For example, if the student shows adding ten blocks to both sides of a balance, students should also be writing the corresponding equation (after a few experiences with just working with the blocks) in symbolic form (e.g., students might write $x - 10 + 10 = 3 + 10$). By writing the process symbolically, the students are engaged in making sense of the processes of abstraction which are foundational to mathematical theory and its development.

Representation: Mathematical ideas can be represented and manipulated in a variety of formats including: concrete manipulatives, visual designs, physical movements, and symbolic notation. Students need to have experiences in working with many different types of representations and in transferring and translating knowledge between the different forms of representations.

Appendix B: Two Grades at a Glance

The chart below shows the outcomes of mathematics in grades K and 1 in each of the four strands with the outcomes lined up to show the flow of content development.

Number Strand		
	Kindergarten	**Grade 1**
Whole Numbers		
	NK.1 Say the number sequence by 1s starting anywhere from 0 to 10 and from 10 to 0. [C, CN, V]	N1.1 Say the number sequence, 0 to 100, by: • 1s forward and backward between any two given whole numbers • 2s to 20, forward starting at 0 • 5s and 10s to 100, forward starting at 0. [C, CN, ME, V]
	NK.2 Recognize, at a glance, and name familiar arrangements of 1 to 5 objects, dots, and pictures. [C, CN, ME, V]	N1.2 Recognize, at a glance, and name familiar arrangements of 1 to 10 objects, dots, and pictures. [C, CN, ME, V]
	NK.3 Relate a numeral, 0 to 10, to its respective quantity. [CN, R, V]	N1.3 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]
		N1.6 Estimate quantities to 20 by using referents. [C, ME, PS, R, V]

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

Number Strand		
	Kindergarten	**Grade 1**
Representation		
	NK.4 Represent and describe numbers 2 to 10, concretely and pictorially. [C, CN, ME, R, V]	N1.4 Represent and describe whole numbers to 20 concretely, pictorially, and symbolically. [C, CN, ME, R, V]
Comparison		
	NK.5 Compare quantities, 1 to 10, using one-to-one correspondence. [C, CN, V]	N1.5 Compare sets containing up to 20 elements to solve problems using: • referents (known quantity) • one-to-one correspondence. [C, CN, ME, PS, R, V]
Ordinal Numbers		
Place Value		
		N1.7 Demonstrate, concretely, physically, and pictorially, how whole numbers can be represented by a variety of equal groupings with and without singles. [C, R, V]

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

Number Strand		
	Kindergarten	**Grade 1**
Adding and Subtracting Whole Numbers		
		N1.8 Identify the number, up to 20, that is one more, two more, one less, and two less than a given number. [C, CN, ME, R, V]
		N1.9 Demonstrate an understanding of addition of numbers with answers to 20 and corresponding subtraction facts, concretely, pictorially, physically, and symbolically by: • using familiar and mathematical language to describe additive and subtractive actions from experience • 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]

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

Number Strand		
	Kindergarten	**Grade 1**
Adding and Subtracting Whole Numbers		
		N1.10 Describe and use mental mathematics strategies (memorization not intended), such as: • counting on and counting back • making 10 • doubles • using addition to subtract to determine basic addition facts to18 and related subtraction facts. [C, CN, ME, PS, R, V]

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

Patterns and Relations Strand		
	Kindergarten	**Grade 1**
Repeating Patterns		
	PK.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]	P1.1 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]
		P1.2 Translate repeating patterns from one form of representation to another. [C, R, V]
Increasing Patterns		

Patterns and Relations Strand		
	Kindergarten	**Grade 1**
Equality and Inequality		
		P1.3 Describe equality as a balance and inequality as an imbalance, concretely, physically, and pictorially (0 to 20). [C, CN, R, V]
		P1.4 Record equalities using the equal symbol. [C, CN, PS, V]

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

Shape and Space Strand		
	Kindergarten	**Grade 1**
Time		
Direct Comparison		
	SSK.1 Use direct comparison to compare two objects based on a single attribute, such as length including height, mass, volume, and capacity. [C, CN, PS, R, V]	SS1.1 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]
Indirect Comparison		

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

Shape and Space Strand		
	Kindergarten	**Grade 1**
3-D Objects		
	SSK.2 Sort 3-D objects using a single attribute. [C, CN, PS, R, V]	
	SSK.3 Build and describe 3-D objects. [CN, PS, V]	
2-D Shapes		
3-D Objects and 2-D Shapes		
		SS1.2 Sort 3-D objects and 2-D shapes using one attribute, and explain the sorting rule. [C, CN, R, V]
		SS1.3 Replicate composite 2-D shapes and 3-D objects. [CN, PS, V]
		SS1.4 Compare 2-D shapes to parts of 3-D objects in the environment. [C, CN, V]

Statistics and Probability Strand		
	Kindergarten	**Grade 1**
Collecting Data		
Representing Data		

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