

# MATHEMATICS (REVISED OC 2005-06)



## Mathematics (Kindergarten Expectations, 2006)

### Overall Expectation

**A** Demonstrate an understanding of number, using concrete materials to explore and investigate counting, quantity, and number relationships;

**B** Measure and compare length, mass, capacity, area, temperature of objects/materials, and the passage of time, using non-standard units, through free exploration, focused exploration, and guided activity;

**C** Describe, sort, classify, and compare two-dimensional shapes and three-dimensional figures, and describe the location and movement of objects through investigation;

**D** Explore, recognize, describe, and create patterns, using a variety of materials in different contexts;

**E** Sort, classify, and display a variety of concrete objects, collect data, begin to read and describe displays of data, and begin to explore the concept of probability in everyday contexts.

### Number Sense and Numeration (Quantity Relationships; Counting; Operational Sense)

**Km1** Investigate the idea that quantity is greater when counting forwards and less when counting backwards;

**Km2** Investigate some concepts of quantity through identifying and comparing sets with more, fewer, or the same number of objects;

**Km3** Recognize some quantities without having to count, using a variety of tools;

**Km4** Begin to use information to estimate the number in a small set;

**Km5** Use, read, and represent whole numbers to 10 in a variety of meaningful contexts;

**Km6** Use ordinal numbers in a variety of everyday contexts;

**Km7** Demonstrate an understanding of number relationships for numbers from 0 to 10, through investigation;

**Km8** Investigate and develop strategies for composing and decomposing quantities to 10;

**Km9** Explore different Canadian coins, using coin manipulatives;

**Km10** Demonstrate understanding of the counting concepts of stable order and of order irrelevance;

**Km11** Begin to make use of one-to-one correspondence in counting objects and matching groups of objects;

**Km12** Investigate addition and subtraction in everyday activities through the use of manipulatives, visual models, or oral exploration.

### Measurement (Attributes, Units, and Measurement Sense; Measurement Relationships)

**Km13** Compare and order two or more objects according to an appropriate measure, and use measurement terms;

**Km14** Demonstrate, through investigation, an awareness of the use of different measurement tools for measuring different things;

**Km15** Demonstrate awareness of non-standard measuring devices and strategies for using them;

**Km16** Demonstrate, through investigation, a beginning understanding of the use of non-standard units of the same size.

### Geometry and Spatial Sense (Geometric Properties; Geometric Relationships; Location and Movement)

**Km17** Explore, sort, and compare traditional and non-traditional two-dimensional shapes and three-dimensional figures;

**Km18** Identify and describe, using common geometric terms, two-dimensional shapes and three-dimensional figures through investigations with concrete materials;

**Km19** Compose pictures and build designs, shapes, and patterns in two-dimensional shapes, and decompose two-dimensional shapes into smaller shapes, using various tools or strategies;

**Km20** Build three-dimensional structures using a variety of materials, and begin to recognize the three-dimensional figures that the structure contains;

**Km21** Investigate the relationship between two-dimensional shapes and three-dimensional figures in objects that they have made;

**Km22** Demonstrate an understanding of basic spatial relationships and movements.

### Patterning (Patterns and Relationships)

**Km23** Identify, extend, reproduce, and create repeating patterns through investigation, using a variety of materials and actions;

**Km24** Identify and describe informally the repeating nature of patterns in everyday contexts, using oral expressions and gestures.

### Data Management and Probability (Collection and Organization of Data; Data Relationships; Probability)

**Km25** Sort, classify, and compare objects and describe the attributes used;

**Km26** Collect objects or data and make representations of their observations, using concrete graphs;

**Km27** Respond to and pose questions about data collection and graphs;

**Km28** Use mathematical language in informal discussions to describe probability.

## Mathematics (Grade 1 Expectations, 2005)

### Mathematical Process Expectations

**1m1** Apply developing problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;

**1m2** Apply developing reasoning skills (e.g., pattern recognition, classification) to make and investigate conjectures (e.g., through discussion with others);

**1m3** Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by explaining to others why they think their solution is correct);

**1m4** Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;

**1m5** Make connections among simple mathematical concepts and procedures, and relate mathematical ideas to situations drawn from everyday contexts;

**1m6** Create basic representations of simple mathematical ideas (e.g., using concrete materials; physical actions, such as hopping or clapping; pictures; numbers; diagrams; invented symbols), make connections among them, and apply them to solve problems;

**1m7** Communicate mathematical thinking orally, visually, and in writing, using everyday language, a developing mathematical vocabulary, and a variety of representations.

## Number Sense and Numeration

- 1m8** Read, represent, compare, and order whole numbers to 50, and use concrete materials to investigate fractions and money amounts;
- 1m9** Demonstrate an understanding of magnitude by counting forward to 100 and backwards from 20;
- 1m10** Solve problems involving the addition and subtraction of single-digit whole numbers, using a variety of strategies.
- 1m11** Represent, compare, and order whole numbers to 50, using a variety of tools (e.g., connecting cubes, ten frames, base ten materials, number lines, hundreds charts) and contexts (e.g., real-life experiences, number stories);
- 1m12** Read and print in words whole numbers to ten, using meaningful contexts (e.g., storybooks, posters);
- 1m13** Demonstrate, using concrete materials, the concept of conservation of number (e.g., 5 counters represent the number 5, regardless whether they are close together or far apart);
- 1m14** Relate numbers to the anchors of 5 and 10 (e.g., 7 is 2 more than 5 and 3 less than 10);
- 1m15** Identify and describe various coins (i.e., penny, nickel, dime, quarter, \$1 coin, \$2 coin), using coin manipulatives or drawings, and state their value (e.g., the value of a penny is one cent; the value of a toonie is two dollars);
- 1m16** Represent money amounts to 20¢, through investigation using coin manipulatives;
- 1m17** Estimate the number of objects in a set, and check by counting (e.g., "I guessed that there were 20 cubes in the pile. I counted them and there were only 17 cubes. 17 is close to 20.");
- 1m18** Compose and decompose numbers up to 20 in a variety of ways, using concrete materials (e.g., 7 can be decomposed using connecting cubes into 6 and 1, or 5 and 2, or 4 and 3);
- 1m19** Divide whole objects into parts and identify and describe, through investigation, equal-sized parts of the whole, using fractional names (e.g., halves; fourths or quarters);
- 1m20** Demonstrate, using concrete materials, the concept of one-to-one correspondence between number and objects when counting;
- 1m21** Count forward by 1's, 2's, 5's, and 10's to 100, using a variety of tools and strategies (e.g., move with steps; skip count on a number line; place counters on a hundreds chart; connect cubes to show equal groups; count groups of pennies, nickels, or dimes);
- 1m22** Count backwards by 1's from 20 and any number less than 20 (e.g., count backwards from 18 to 11), with and without the use of concrete materials and number lines;
- 1m23** Count backwards from 20 by 2's and 5's, using a variety of tools (e.g., number lines, hundreds charts);
- 1m24** Use ordinal numbers to thirty-first in meaningful contexts (e.g., identify the days of the month on a calendar).
- 1m25** Solve a variety of problems involving the addition and subtraction of whole numbers to 20, using concrete materials and drawings (e.g., pictures, number lines) (Sample problem: Miguel has 12 cookies. Seven cookies are chocolate. Use counters to determine how many cookies are not chocolate.);
- 1m26** Solve problems involving the addition and subtraction of single-digit whole numbers, using a variety of mental strategies (e.g., one more than, one less than, counting on, counting back, doubles);
- 1m27** Add and subtract money amounts to 10¢, using coin manipulatives and drawings.

## Measurement

- 1m28** Estimate, measure, and describe length, area, mass, capacity, time, and temperature, using non-standard units of the same size;
- 1m29** Compare, describe, and order objects, using attributes measured in non-standard units;
- 1m30** Demonstrate an understanding of the use of non-standard units of the same size (e.g., straws, index cards) for measuring (Sample problem: Measure the length of your desk in different ways; for example, by using several different non-standard units or by starting measurements from opposite ends of the desk. Discuss your findings.);
- 1m31** Estimate, measure (i.e., by placing non-standard units repeatedly, without overlaps or gaps), and record lengths, heights, and distances (e.g., a book is about 10 paper clips wide; a pencil is about 3 toothpicks long);
- 1m32** Construct, using a variety of strategies, tools for measuring lengths, heights, and distances in non-standard units (e.g., footprints on cash register tape or on connecting cubes);
- 1m33** Estimate, measure (i.e., by minimizing overlaps and gaps), and describe area, through investigation using non-standard units (e.g., "It took about 15 index cards to cover my desk, with only a little bit of space left over.");
- 1m34** Estimate, measure, and describe the capacity and/or mass of an object, through investigation using non-standard units (e.g., "My journal has the same mass as 13 pencils." "The juice can has the same capacity as 4 pop cans.");
- 1m35** Estimate, measure, and describe the passage of time, through investigation using nonstandard units (e.g., number of sleeps; number of claps; number of flips of a sand timer);
- 1m36** Read demonstration digital and analogue clocks, and use them to identify benchmark times (e.g., times for breakfast, lunch, dinner; the start and end of school; bedtime) and to tell and write time to the hour and half-hour in everyday settings;
- 1m37** Name the months of the year in order, and read the date on a calendar;
- 1m38** Relate temperature to experiences of the seasons (e.g., "In winter, we can skate because it's cold enough for there to be ice.");
- 1m39** Compare two or three objects using measurable attributes (e.g., length, height, width, area, temperature, mass, capacity), and describe the objects using relative terms (e.g., taller, heavier, faster, bigger, warmer; "If I put an eraser, a pencil, and a metre stick beside each other, I can see that the eraser is shortest and the metre stick is longest.");
- 1m40** Compare and order objects by their linear measurements, using the same non-standard unit (Sample problem: Using a length of string equal to the length of your forearm, work with a partner to find other objects that are about the same length.);
- 1m41** Use the metre as a benchmark for measuring length, and compare the metre with non-standard units (Sample problem: In the classroom, use a metre stick to find objects that are taller than one metre and objects that are shorter than one metre.);
- 1m42** Describe, through investigation using concrete materials, the relationship between the size of a unit and the number of units needed to measure length (Sample problem: Compare the numbers of paper clips and pencils needed to measure the length of the same table.).

## Geometry and Spatial Sense

- 1m43** Identify common two-dimensional shapes and three-dimensional figures and sort and classify them by their attributes;
- 1m44** Compose and decompose common two-dimensional shapes and three-dimensional figures;
- 1m45** Describe the relative locations of objects using positional language;
- 1m46** Identify and describe common two-dimensional shapes (e.g., circles, triangles, rectangles, squares) and sort and classify them by their attributes (e.g., colour; size; texture; number of sides), using concrete materials and pictorial representations (e.g., "I put all the triangles in one group. Some are long and skinny, and some are short and fat, but they all have three sides.");
- 1m47** Trace and identify the two-dimensional faces of three-dimensional figures, using concrete models (e.g., "I can see squares on the cube.");

- 1m48** Identify and describe common three-dimensional figures (e.g., cubes, cones, cylinders, spheres, rectangular prisms) and sort and classify them by their attributes (e.g., colour; size; texture; number and shape of faces), using concrete materials and pictorial representations (e.g., "I put the cones and the cylinders in the same group because they all have circles on them.");
- 1m49** Describe similarities and differences between an everyday object and a three-dimensional figure (e.g., "A water bottle looks like a cylinder, except the bottle gets thinner at the top.");
- 1m50** Locate shapes in the environment that have symmetry, and describe the symmetry;
- 1m51** Compose patterns, pictures, and designs, using common two-dimensional shapes (Sample problem: Create a picture of a flower using pattern blocks.);
- 1m52** Identify and describe shapes within other shapes (e.g., shapes within a geometric design);
- 1m53** Build three-dimensional structures using concrete materials, and describe the two-dimensional shapes the structures contain;
- 1m54** Cover outline puzzles with two-dimensional shapes (e.g., pattern blocks, tangrams) (Sample problem: Fill in the outline of a boat with tangram pieces.);
- 1m55** Describe the relative locations of objects or people using positional language (e.g., over, under, above, below, in front of, behind, inside, outside, beside, between, along);
- 1m56** Describe the relative locations of objects on concrete maps created in the classroom (Sample problem: Work with your group to create a map of the classroom in the sand table, using smaller objects to represent the classroom objects. Describe where the teacher's desk and the bookshelves are located.);
- 1m57** Create symmetrical designs and pictures, using concrete materials (e.g., pattern blocks, connecting cubes, paper for folding), and describe the relative locations of the parts.

### **Patterning and Algebra**

- 1m58** *Identify, describe, extend, and create repeating patterns;*
- 1m59** *Demonstrate an understanding of the concept of equality, using concrete materials and addition and subtraction to 10;*
- 1m60** Identify, describe, and extend, through investigation, geometric repeating patterns involving one attribute (e.g., colour, size, shape, thickness, orientation);
- 1m61** Identify and extend, through investigation, numeric repeating patterns (e.g., 1, 2, 3, 1, 2, 3, 1, 2, 3, ...);
- 1m62** Describe numeric repeating patterns in a hundreds chart;
- 1m63** Identify a rule for a repeating pattern (e.g., "We're lining up boy, girl, boy, girl, boy, girl.");
- 1m64** Create a repeating pattern involving one attribute (e.g., colour, size, shape, sound) (Sample problem: Use beads to make a string that shows a repeating pattern involving one attribute.);
- 1m65** Represent a given repeating pattern in a variety of ways (e.g., pictures, actions, colours, sounds, numbers, letters) (Sample problem: Make an ABA, ABA, ABA pattern using actions like clapping or tapping.);
- 1m66** Create a set in which the number of objects is greater than, less than, or equal to the number of objects in a given set;
- 1m67** Demonstrate examples of equality, through investigation, using a "balance" model (Sample problem: Demonstrate, using a pan balance, that a train of 7 attached cubes on one side balances a train of 3 cubes and a train of 4 cubes on the other side.);
- 1m68** Determine, through investigation using a "balance" model and whole numbers to 10, the number of identical objects that must be added or subtracted to establish equality (Sample problem: On a pan balance, 5 cubes are placed on the left side and 8 cubes are placed on the right side. How many cubes should you take off the right side so that both sides balance?).

### **Data Management and Probability**

- 1m69** *Collect and organize categorical primary data and display the data using concrete graphs and pictographs, without regard to the order of labels on the horizontal axis;*
- 1m70** *Read and describe primary data presented in concrete graphs and pictographs;*
- 1m71** *Describe the likelihood that everyday events will happen;*
- 1m72** Demonstrate an ability to organize objects into categories by sorting and classifying objects using one attribute (e.g., colour, size), and by describing informal sorting experiences (e.g., helping to put away groceries) (Sample problem: Sort a collection of attribute blocks by colour. Re-sort the same collection by shape.);
- 1m73** Collect and organize primary data (e.g., data collected by the class) that is categorical (i.e., that can be organized into categories based on qualities such as colour or hobby), and display the data using one-to-one correspondence, prepared templates of concrete graphs and pictographs (with titles and labels), and a variety of recording methods (e.g., arranging objects, placing stickers, drawing pictures, making tally marks) (Sample problem: Collect and organize data about the favourite fruit that students in your class like to eat.);
- 1m74** Read primary data presented in concrete graphs and pictographs, and describe the data using comparative language (e.g., more students chose summer than winter as their single favourite season);
- 1m75** Pose and answer questions about collected data (Sample problem: What was the most popular fruit chosen by the students in your class?);
- 1m76** Describe the likelihood that everyday events will occur, using mathematical language (i.e., impossible, unlikely, less likely, more likely, certain) (e.g., "It's unlikely that I will win the contest shown on the cereal box.").

## **Mathematics (Grade 2 Expectations, 2005)**

### **Mathematical Process Expectations**

- 2m1** Apply developing problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
- 2m2** Apply developing reasoning skills (e.g., pattern recognition, classification) to make and investigate conjectures (e.g., through discussion with others);
- 2m3** Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by explaining to others why they think their solution is correct);
- 2m4** Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;
- 2m5** Make connections among simple mathematical concepts and procedures, and relate mathematical ideas to situations drawn from everyday contexts;
- 2m6** Create basic representations of simple mathematical ideas (e.g., using concrete materials; physical actions, such as hopping or clapping; pictures; numbers; diagrams; invented symbols), make connections among them, and apply them to solve problems;

**2m7** Communicate mathematical thinking orally, visually, and in writing, using everyday language, a developing mathematical vocabulary, and a variety of representations.

### **Number Sense and Numeration**

- 2m8** Read, represent, compare, and order whole numbers to 100, and use concrete materials to represent fractions and money amounts to 100¢;
- 2m9** Demonstrate an understanding of magnitude by counting forward to 200 and backwards from 50, using multiples of various numbers as starting points;
- 2m10** Solve problems involving the addition and subtraction of one- and two-digit whole numbers, using a variety of strategies, and investigate multiplication and division;
- 2m11** Represent, compare, and order whole numbers to 100, including money amounts to 100¢, using a variety of tools (e.g., ten frames, base ten materials, coin manipulatives, number lines, hundreds charts and hundreds carpets);
- 2m12** Read and print in words whole numbers to twenty, using meaningful contexts (e.g., storybooks, posters, signs);
- 2m13** Compose and decompose two-digit numbers in a variety of ways, using concrete materials (e.g., place 42 counters on ten frames to show 4 tens and 2 ones; compose 37¢ using one quarter, one dime, and two pennies) (Sample problem: Use base ten blocks to show 60 in different ways.);
- 2m14** Determine, using concrete materials, the ten that is nearest to a given two-digit number, and justify the answer (e.g., use counters on ten frames to determine that 47 is closer to 50 than to 40);
- 2m15** Determine, through investigation using concrete materials, the relationship between the number of fractional parts of a whole and the size of the fractional parts (e.g., a paper plate divided into fourths has larger parts than a paper plate divided into eighths) (Sample problem: Use paper squares to show which is bigger, one half of a square or one fourth of a square.);
- 2m16** Regroup fractional parts into wholes, using concrete materials (e.g., combine nine fourths to form two wholes and one fourth);
- 2m17** Compare fractions using concrete materials, without using standard fractional notation (e.g., use fraction pieces to show that three fourths are bigger than one half, but smaller than one whole);
- 2m18** Estimate, count, and represent (using the ¢ symbol) the value of a collection of coins with a maximum value of one dollar.
- 2m19** Count forward by 1's, 2's, 5's, 10's, and 25's to 200, using number lines and hundreds charts, starting from multiples of 1, 2, 5, and 10 (e.g., count by 5's from 15; count by 25's from 125);
- 2m20** Count backwards by 1's from 50 and any number less than 50, and count backwards by 10's from 100 and any number less than 100, using number lines and hundreds charts (Sample problem: Count backwards from 87 on a hundreds carpet, and describe any patterns you see.);
- 2m21** Locate whole numbers to 100 on a number line and on a partial number line (e.g., locate 37 on a partial number line that goes from 34 to 41);
- 2m22** Solve problems involving the addition and subtraction of whole numbers to 18, using a variety of mental strategies (e.g., "To add  $6 + 8$ , I could double 6 and get 12 and then add 2 more to get 14.");
- 2m23** Describe relationships between quantities by using whole-number addition and subtraction (e.g., "If you ate 7 grapes and I ate 12 grapes, I can say that I ate 5 more grapes than you did, or you ate 5 fewer grapes than I did.");
- 2m24** Represent and explain, through investigation using concrete materials and drawings, multiplication as the combining of equal groups (e.g., use counters to show that 3 groups of 2 is equal to  $2 + 2 + 2$  and to  $3 \times 2$ );
- 2m25** Represent and explain, through investigation using concrete materials and drawings, division as the sharing of a quantity equally (e.g., "I can share 12 carrot sticks equally among 4 friends by giving each person 3 carrot sticks.");
- 2m26** Solve problems involving the addition and subtraction of two-digit numbers, with and without regrouping, using concrete materials (e.g., base ten materials, counters), student-generated algorithms, and standard algorithms;
- 2m27** Add and subtract money amounts to 100¢, using a variety of tools (e.g., concrete materials, drawings) and strategies (e.g., counting on, estimating, representing using symbols).

### **Measurement**

- 2m28** Estimate, measure, and record length, perimeter, area, mass, capacity, time, and temperature, using non-standard units and standard units;
- 2m29** Compare, describe, and order objects, using attributes measured in non-standard units and standard units;
- 2m30** Choose benchmarks – in this case, personal referents – for a centimetre and a metre (e.g., "My little finger is about as wide as one centimetre. A really big step is about one metre.") to help them perform measurement tasks;
- 2m31** Estimate and measure length, height, and distance, using standard units (i.e., centimetre, metre) and non-standard units;
- 2m32** Record and represent measurements of length, height, and distance in a variety of ways (e.g., written, pictorial, concrete) (Sample problem: Investigate how the steepness of a ramp affects the distance an object travels. Use cash-register tape for recording distances.);
- 2m33** Select and justify the choice of a standard unit (i.e., centimetre or metre) or a nonstandard unit to measure length (e.g., "I needed a fast way to check that the two teams would race the same distance, so I used paces.");
- 2m34** Estimate, measure, and record the distance around objects, using non-standard units (Sample problem: Measure around several different doll beds using string, to see which bed is the longest around.);
- 2m35** Estimate, measure, and record area, through investigation using a variety of non-standard units (e.g., determine the number of yellow pattern blocks it takes to cover an outlined shape) (Sample problem: Cover your desk with index cards in more than one way. See if the number of index cards needed stays the same each time.);
- 2m36** Estimate, measure, and record the capacity and/or mass of an object, using a variety of non-standard units (e.g., "I used the pan balance and found that the stapler has the same mass as my pencil case.");
- 2m37** Tell and write time to the quarter-hour, using demonstration digital and analogue clocks (e.g., "My clock shows the time recess will start [10:00], and my friend's clock shows the time recess will end [10:15].");
- 2m38** Construct tools for measuring time intervals in non-standard units (e.g., a particular bottle of water takes about five seconds to empty);
- 2m39** Describe how changes in temperature affect everyday experiences (e.g., the choice of clothing to wear);
- 2m40** Use a standard thermometer to determine whether temperature is rising or falling (e.g., the temperature of water, air);
- 2m41** Describe, through investigation, the relationship between the size of a unit of area and the number of units needed to cover a surface (Sample problem: Compare the numbers of hexagon pattern blocks and triangle pattern blocks needed to cover the same book.);
- 2m42** Compare and order a collection of objects by mass and/or capacity, using non-standard units (e.g., "The coffee can holds more sand than the soup can, but the same amount as the small pail.");
- 2m43** Determine, through investigation, the relationship between days and weeks and between months and years.

### **Geometry and Spatial Sense**

- 2m44** Identify two-dimensional shapes and three-dimensional figures and sort and classify them by their geometric properties;
- 2m45** Compose and decompose two-dimensional shapes and three-dimensional figures;
- 2m46** Describe and represent the relative locations of objects, and represent objects on a map;
- 2m47** Distinguish between the attributes of an object that are geometric properties (e.g., number of sides, number of faces) and the attributes that are not geometric properties (e.g., colour, size, texture), using a variety of tools (e.g., attribute blocks, geometric solids, connecting cubes);

- 2m48** Identify and describe various polygons (i.e., triangles, quadrilaterals, pentagons, hexagons, heptagons, octagons) and sort and classify them by their geometric properties (i.e., number of sides or number of vertices), using concrete materials and pictorial representations (e.g., "I put all the figures with five or more vertices in one group, and all the figures with fewer than five vertices in another group.");
- 2m49** Identify and describe various three-dimensional figures (i.e., cubes, prisms, pyramids) and sort and classify them by their geometric properties (i.e., number and shape of faces), using concrete materials (e.g., "I separated the figures that have square faces from the ones that don't.");
- 2m50** Create models and skeletons of prisms and pyramids, using concrete materials (e.g., cardboard; straws and modeling clay), and describe their geometric properties (i.e., number and shape of faces, number of edges);
- 2m51** Locate the line of symmetry in a two-dimensional shape (e.g., by paper folding; by using a Mira);
- 2m52** Compose and describe pictures, designs, and patterns by combining two-dimensional shapes (e.g., "I made a picture of a flower from one hexagon and six equilateral triangles.");
- 2m53** Compose and decompose two-dimensional shapes (Sample problem: Use Power Polygons to show if you can compose a rectangle from two triangles of different sizes.);
- 2m54** Cover an outline puzzle with two-dimensional shapes in more than one way;
- 2m55** Build a structure using three-dimensional figures, and describe the two-dimensional shapes and three-dimensional figures in the structure (e.g., "I used a box that looks like a triangular prism to build the roof of my house.");
- 2m56** Describe the relative locations (e.g., beside, two steps to the right of ) and the movements of objects on a map (e.g., "The path shows that he walked around the desk, down the aisle, and over to the window.");
- 2m57** Draw simple maps of familiar settings, and describe the relative locations of objects on the maps (Sample problem: Draw a map of the classroom, showing the locations of the different pieces of furniture.);
- 2m58** Create and describe symmetrical designs using a variety of tools (e.g., pattern blocks, tangrams, paper and pencil).

### **Patterning and Algebra**

- 2m59** *Identify, describe, extend, and create repeating patterns, growing patterns, and shrinking patterns;*
- 2m60** *Demonstrate an understanding of the concept of equality between pairs of expressions, using concrete materials, symbols, and addition and subtraction to 18.*
- 2m61** Identify and describe, through investigation, growing patterns and shrinking patterns generated by the repeated addition or subtraction of 1's, 2's, 5's, 10's, and 25's on a number line and on a hundreds chart (e.g., the numbers 90, 80, 70, 60, 50, 40, 30, 20, 10 are in a straight line on a hundreds chart);
- 2m62** Identify, describe, and create, through investigation, growing patterns and shrinking patterns involving addition and subtraction, with and without the use of calculators (e.g.,  $3 + 1 = 4$ ,  $3 + 2 = 5$ ,  $3 + 3 = 6$ , ...);
- 2m63** Identify repeating, growing, and shrinking patterns found in real-life contexts (e.g., a geometric pattern on wallpaper, a rhythm pattern in music, a number pattern when counting dimes);
- 2m64** Represent a given growing or shrinking pattern in a variety of ways (e.g., using pictures, actions, colours, sounds, numbers, letters, number lines, bar graphs) (Sample problem: Show the letter pattern A, AA, AAA, AAAA, ... by clapping or hopping.);
- 2m65** Create growing or shrinking patterns (Sample problem: Create a shrinking pattern using cut-outs of pennies and/or nickels, starting with 20 cents.);
- 2m66** Create a repeating pattern by combining two attributes (e.g., colour and shape; colour and size) (Sample problem: Use attribute blocks to make a train that shows a repeating pattern involving two attributes.);
- 2m67** Demonstrate, through investigation, an understanding that a pattern results from repeating an operation (e.g., addition, subtraction) or making a repeated change to an attribute (e.g., colour, orientation).
- 2m68** Demonstrate an understanding of the concept of equality by partitioning whole numbers to 18 in a variety of ways, using concrete materials (e.g., starting with 9 tiles and adding 6 more tiles gives the same result as starting with 10 tiles and adding 5 more tiles);
- 2m69** Represent, through investigation with concrete materials and pictures, two number expressions that are equal, using the equal sign (e.g., "I can break a train of 10 cubes into 4 cubes and 6 cubes. I can also break 10 cubes into 7 cubes and 3 cubes. This means  $4 + 6 = 7 + 3$ .");
- 2m70** Determine the missing number in equations involving addition and subtraction to 18, using a variety of tools and strategies (e.g., modelling with concrete materials, using guess and check with and without the aid of a calculator) (Sample problem: Use counters to determine the missing number in the equation  $6 + 7 = \_ + 5$ .);
- 2m71** Identify, through investigation, and use the commutative property of addition (e.g., create a train of 10 cubes by joining 4 red cubes to 6 blue cubes, or by joining 6 blue cubes to 4 red cubes) to facilitate computation with whole numbers (e.g., "I know that  $9 + 8 + 1 = 9 + 1 + 8$ . Adding becomes easier because that gives  $10 + 8 = 18$ .");
- 2m72** Identify, through investigation, the properties of zero in addition and subtraction (i.e., when you add zero to a number, the number does not change; when you subtract zero from a number, the number does not change).

### **Data Management and Probability**

- 2m73** *Collect and organize categorical or discrete primary data and display the data, using tally charts, concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers, with labels ordered appropriately along horizontal axes, as needed;*
- 2m74** *Read and describe primary data presented in tally charts, concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers;*
- 2m75** *Describe probability in everyday situations and simple games;*
- 2m76** Demonstrate an ability to organize objects into categories, by sorting and classifying objects using two attributes simultaneously (e.g., sort attribute blocks by colour and shape at the same time);
- 2m77** Gather data to answer a question, using a simple survey with a limited number of responses (e.g., What is your favourite season?; How many letters are in your first name?);
- 2m78** Collect and organize primary data (e.g., data collected by the class) that is categorical or discrete (i.e., that can be counted, such as the number of students absent), and display the data using one-to-one correspondence in concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers (e.g., tally charts, diagrams), with appropriate titles and labels and with labels ordered appropriately along horizontal axes, as needed (Sample problem: Record the number of times that specific words are used in a simple rhyme or poem.);
- 2m79** Read primary data presented in concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers (e.g., tally charts, diagrams), and describe the data using mathematical language (e.g., "Our bar graph shows that 4 more students walk to school than take the bus.");
- 2m80** Pose and answer questions about class-generated data in concrete graphs, pictographs, line plots, simple bar graphs, and tally charts (e.g., Which is the least favourite season?);
- 2m81** Distinguish between numbers that represent data values (e.g., "I have 4 people in my family.") and numbers that represent the frequency of an event (e.g., "There are 10 children in my class who have 4 people in their family.");

- 2m82** Demonstrate an understanding of data displayed in a graph (e.g., by telling a story, by drawing a picture), by comparing different parts of the data and by making statements about the data as a whole (e.g., "I looked at the graph that shows how many students were absent each month. More students were away in January than in September.");
- 2m83** Describe probability as a measure of the likelihood that an event will occur, using mathematical language (i.e., impossible, unlikely, less likely, equally likely, more likely, certain) (e.g., "If I take a new shoe out of a box without looking, it's equally likely that I will pick the left shoe or the right shoe.");
- 2m84** Describe the probability that an event will occur (e.g., getting heads when tossing a coin, landing on red when spinning a spinner), through investigation with simple games and probability experiments and using mathematical language (e.g., "I tossed 2 coins at the same time, to see how often I would get 2 heads. I found that getting a head and a tail was more likely than getting 2 heads.") (Sample problem: Describe the probability of spinning red when you spin a spinner that has one half shaded yellow, one fourth shaded blue, and one fourth shaded red. Experiment with the spinner to see if the results are what you expected.).

## Mathematics (Grade 3 Expectations, 2005)

### Mathematical Process Expectations

- 3m1** Apply developing problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
- 3m2** Apply developing reasoning skills (e.g., pattern recognition, classification) to make and investigate conjectures (e.g., through discussion with others);
- 3m3** Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by explaining to others why they think their solution is correct);
- 3m4** Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;
- 3m5** Make connections among simple mathematical concepts and procedures, and relate mathematical ideas to situations drawn from everyday contexts;
- 3m6** Create basic representations of simple mathematical ideas (e.g., using concrete materials; physical actions, such as hopping or clapping; pictures; numbers; diagrams; invented symbols), make connections among them, and apply them to solve problems;
- 3m7** Communicate mathematical thinking orally, visually, and in writing, using everyday language, a developing mathematical vocabulary, and a variety of representations.

### Number Sense and Numeration

- 3m8** *Read, represent, compare, and order whole numbers to 1000, and use concrete materials to represent fractions and money amounts to \$10;*
- 3m9** *Demonstrate an understanding of magnitude by counting forward and backwards by various numbers and from various starting points;*
- 3m10** *Solve problems involving the addition and subtraction of single- and multi-digit whole numbers, using a variety of strategies, and demonstrate an understanding of multiplication and division.*
- 3m11** Represent, compare, and order whole numbers to 1000, using a variety of tools (e.g., base ten materials or drawings of them, number lines with increments of 100 or other appropriate amounts);
- 3m12** Read and print in words whole numbers to one hundred, using meaningful contexts (e.g., books, speed limit signs);
- 3m13** Identify and represent the value of a digit in a number according to its position in the number (e.g., use base ten materials to show that the 3 in 324 represents 3 hundreds);
- 3m14** Compose and decompose three-digit numbers into hundreds, tens, and ones in a variety of ways, using concrete materials (e.g., use base ten materials to decompose 327 into 3 hundreds, 2 tens, and 7 ones, or into 2 hundreds, 12 tens, and 7 ones);
- 3m15** Round two-digit numbers to the nearest ten, in problems arising from real-life situations;
- 3m16** Represent and explain, using concrete materials, the relationship among the numbers 1, 10, 100, and 1000, (e.g., use base ten materials to represent the relationship between a decade and a century, or a century and a millennium);
- 3m17** Divide whole objects and sets of objects into equal parts, and identify the parts using fractional names (e.g., one half; three thirds; two fourths or two quarters), without using numbers in standard fractional notation;
- 3m18** Represent and describe the relationships between coins and bills up to \$10 (e.g., "There are eight quarters in a toonie and ten dimes in a loonie.");
- 3m19** Estimate, count, and represent (using the \$ symbol) the value of a collection of coins and bills with a maximum value of \$10;
- 3m20** Solve problems that arise from real-life situations and that relate to the magnitude of whole numbers up to 1000 (Sample problem: Do you know anyone who has lived for close to 1000 days? Explain your reasoning.);
- 3m21** Count forward by 1's, 2's, 5's, 10's, and 100's to 1000 from various starting points, and by 25's to 1000 starting from multiples of 25, using a variety of tools and strategies (e.g., skip count with and without the aid of a calculator; skip count by 10's using dimes);
- 3m22** Count backwards by 2's, 5's, and 10's from 100 using multiples of 2, 5, and 10 as starting points, and count backwards by 100's from 1000 and any number less than 1000, using a variety of tools (e.g., number lines, calculators, coins) and strategies.
- 3m23** Solve problems involving the addition and subtraction of two-digit numbers, using a variety of mental strategies (e.g., to add  $37 + 26$ , add the tens, add the ones, then combine the tens and ones, like this:  $30 + 20 = 50$ ,  $7 + 6 = 13$ ,  $50 + 13 = 63$ );
- 3m24** Add and subtract three-digit numbers, using concrete materials, student-generated algorithms, and standard algorithms;
- 3m25** Use estimation when solving problems involving addition and subtraction, to help judge the reasonableness of a solution;
- 3m26** Add and subtract money amounts, using a variety of tools (e.g., currency manipulatives, drawings), to make simulated purchases and change for amounts up to \$10 (Sample problem: You spent 5 dollars and 75 cents on one item and 10 cents on another item. How much did you spend in total?);
- 3m27** Relate multiplication of one-digit numbers and division by one-digit divisors to real-life situations, using a variety of tools and strategies (e.g., place objects in equal groups, use arrays, write repeated addition or subtraction sentences) (Sample problem: Give a real-life example of when you might need to know that 3 groups of 2 is  $3 \times 2$ .);
- 3m28** Multiply to  $7 \times 7$  and divide to  $49 \div 7$ , using a variety of mental strategies (e.g., doubles, doubles plus another set, skip counting).

### Measurement

- 3m29** *Estimate, measure, and record length, perimeter, area, mass, capacity, time, and temperature, using standard units;*
- 3m30** *Compare, describe, and order objects, using attributes measured in standard units;*
- 3m31** Estimate, measure, and record length, height, and distance, using standard units (i.e., centimetre, metre, kilometre) (Sample problem: While walking with your class, stop when you think you have travelled one kilometre.);

- 3m32** Draw items using a ruler, given specific lengths in centimetres (Sample problem: Draw a pencil that is 5 cm long);
- 3m33** Read time using analogue clocks, to the nearest five minutes, and using digital clocks (e.g., 1:23 means twenty-three minutes after one o'clock), and represent time in 12-hour notation;
- 3m34** Estimate, read (i.e., using a thermometer), and record positive temperatures to the nearest degree Celsius (i.e., using a number line; using appropriate notation) (Sample problem: Record the temperature outside each day using a thermometer, and compare your measurements with those reported in the daily news.);
- 3m35** Identify benchmarks for freezing, cold, cool, warm, hot, and boiling temperatures as they relate to water and for cold, cool, warm, and hot temperatures as they relate to air (e.g., water freezes at 0°C; the air temperature on a warm day is about 20°C, but water at 20°C feels cool);
- 3m36** Estimate, measure, and record the perimeter of two-dimensional shapes, through investigation using standard units (Sample problem: Estimate, measure, and record the perimeter of your notebook.);
- 3m37** Estimate, measure (i.e., using centimetre grid paper, arrays), and record area (e.g., if a row of 10 connecting cubes is approximately the width of a book, skip counting down the cover of the book with the row of cubes [i.e., counting 10, 20, 30, ...] is one way to determine the area of the book cover);
- 3m38** Choose benchmarks for a kilogram and a litre to help them perform measurement tasks;
- 3m39** Estimate, measure, and record the mass of objects (e.g., can of apple juice, bag of oranges, bag of sand), using the standard unit of the kilogram or parts of a kilogram (e.g., half, quarter);
- 3m40** Estimate, measure, and record the capacity of containers (e.g., juice can, milk bag), using the standard unit of the litre or parts of a litre (e.g., half, quarter).
- 3m41** Compare standard units of length (i.e., centimetre, metre, kilometre) (e.g., centimetres are smaller than metres), and select and justify the most appropriate standard unit to measure length;
- 3m42** Compare and order objects on the basis of linear measurements in centimetres and/or metres (e.g., compare a 3 cm object with a 5 cm object; compare a 50 cm object with a 1 m object) in problem-solving contexts;
- 3m43** Compare and order various shapes by area, using congruent shapes (e.g., from a set of pattern blocks or Power Polygons) and grid paper for measuring (Sample problem: Does the order of the shapes change when you change the size of the pattern blocks you measure with?);
- 3m44** Describe, through investigation using grid paper, the relationship between the size of a unit of area and the number of units needed to cover a surface (Sample problem: What is the difference between the numbers of squares needed to cover the front of a book, using centimetre grid paper and using two-centimetre grid paper?);
- 3m45** Compare and order a collection of objects, using standard units of mass (i.e., kilogram) and/or capacity (i.e., litre);
- 3m46** Solve problems involving the relationships between minutes and hours, hours and days, days and weeks, and weeks and years, using a variety of tools (e.g., clocks, calendars, calculators).

### **Geometry and Spatial Sense**

- 3m47** Compare two-dimensional shapes and three-dimensional figures and sort them by their geometric properties;
- 3m48** Describe relationships between two-dimensional shapes, and between two-dimensional shapes and three-dimensional figures;
- 3m49** Identify and describe the locations and movements of shapes and objects;
- 3m50** Use a reference tool (e.g., paper corner, pattern block, carpenter's square) to identify right angles and to describe angles as greater than, equal to, or less than a right angle (Sample problem: Which pattern blocks have angles bigger than a right angle?);
- 3m51** Identify and compare various polygons (i.e., triangles, quadrilaterals, pentagons, hexagons, heptagons, octagons) and sort them by their geometric properties (i.e., number of sides; side lengths; number of interior angles; number of right angles);
- 3m52** Compare various angles, using concrete materials and pictorial representations, and describe angles as bigger than, smaller than, or about the same as other angles (e.g., "Two of the angles on the red pattern block are bigger than all the angles on the green pattern block.");
- 3m53** Compare and sort prisms and pyramids by geometric properties (i.e., number and shape of faces, number of edges, number of vertices), using concrete materials;
- 3m54** Construct rectangular prisms (e.g., using given paper nets; using Polydrons), and describe geometric properties (i.e., number and shape of faces, number of edges, number of vertices) of the prisms;
- 3m55** Solve problems requiring the greatest or least number of two-dimensional shapes (e.g., pattern blocks) needed to compose a larger shape in a variety of ways (e.g., to cover an outline puzzle) (Sample problem: Compose a hexagon using different numbers of smaller shapes.);
- 3m56** Explain the relationships between different types of quadrilaterals (e.g., a square is a rectangle because a square has four sides and four right angles; a rhombus is a parallelogram because opposite sides of a rhombus are parallel);
- 3m57** Identify and describe the two-dimensional shapes that can be found in a three-dimensional figure (Sample problem: Build a structure from blocks, toothpicks, or other concrete materials, and describe it using geometric terms, so that your partner will be able to build your structure without seeing it.);
- 3m58** Describe and name prisms and pyramids by the shape of their base (e.g., rectangular prism, square-based pyramid);
- 3m59** Identify congruent two-dimensional shapes by manipulating and matching concrete materials (e.g., by translating, reflecting, or rotating pattern blocks);
- 3m60** Describe movement from one location to another using a grid map (e.g., to get from the swings to the sandbox, move three squares to the right and two squares down);
- 3m61** Identify flips, slides, and turns, through investigation using concrete materials and physical motion, and name flips, slides, and turns as reflections, translations, and rotations (e.g., a slide to the right is a translation; a turn is a rotation);
- 3m62** Complete and describe designs and pictures of images that have a vertical, horizontal, or diagonal line of symmetry (Sample problem: Draw the missing portion of the given butterfly on grid paper.).

### **Patterning and Algebra**

- 3m63** Describe, extend, and create a variety of numeric patterns and geometric patterns;
- 3m64** Demonstrate an understanding of equality between pairs of expressions, using addition and subtraction of one- and two-digit numbers;
- 3m65** Identify, extend, and create a repeating pattern involving two attributes (e.g., size, colour, orientation, number), using a variety of tools (e.g., pattern blocks, attribute blocks, drawings) (Sample problem: Create a repeating pattern using three colours and two shapes.);
- 3m66** Identify and describe, through investigation, number patterns involving addition, subtraction, and multiplication, represented on a number line, on a calendar, and on a hundreds chart (e.g., the multiples of 9 appear diagonally in a hundreds chart);
- 3m67** Extend repeating, growing, and shrinking number patterns (Sample problem: Write the next three terms in the pattern 4, 8, 12, 16, ....);
- 3m68** Create a number pattern involving addition or subtraction, given a pattern represented on a number line or a pattern rule expressed in words (Sample problem: Make a number pattern that starts at 0 and grows by adding 7 each time.);
- 3m69** Represent simple geometric patterns using a number sequence, a number line, or a bar graph (e.g., the given growing pattern of toothpick squares can be represented numerically by the sequence 4, 7, 10, ..., which represents the number of toothpicks used to make each figure);

- 3m70** Demonstrate, through investigation, an understanding that a pattern results from repeating an action (e.g., clapping, taking a step forward every second), repeating an operation (e.g., addition, subtraction), using a transformation (e.g., slide, flip, turn), or making some other repeated change to an attribute (e.g., colour, orientation).
- 3m71** Determine, through investigation, the inverse relationship between addition and subtraction (e.g., since  $4 + 5 = 9$ , then  $9 - 5 = 4$ ; since  $16 - 9 = 7$ , then  $7 + 9 = 16$ );
- 3m72** Determine, the missing number in equations involving addition and subtraction of one- and two-digit numbers, using a variety of tools and strategies (e.g., modelling with concrete materials, using guess and check with and without the aid of a calculator) (Sample problem: What is the missing number in the equation  $25 - 4 = 15 + \_?$ );
- 3m73** Identify, through investigation, the properties of zero and one in multiplication (i.e., any number multiplied by zero equals zero; any number multiplied by 1 equals the original number) (Sample problem: Use tiles to create arrays that represent  $3 \times 3$ ,  $3 \times 2$ ,  $3 \times 1$ , and  $3 \times 0$ . Explain what you think will happen when you multiply any number by 1, and when you multiply any number by 0.);
- 3m74** Identify, through investigation, and use the associative property of addition to facilitate computation with whole numbers (e.g., "I know that  $17 + 16$  equals  $17 + 3 + 13$ . This is easier to add in my head because I get  $20 + 13 = 33$ .").

#### **Data Management and Probability**

- 3m75** Collect and organize categorical or discrete primary data and display the data using charts and graphs, including vertical and horizontal bar graphs, with labels ordered appropriately along horizontal axes, as needed;
- 3m76** Read, describe, and interpret primary data presented in charts and graphs, including vertical and horizontal bar graphs;
- 3m77** Predict and investigate the frequency of a specific outcome in a simple probability experiment;
- 3m78** Demonstrate an ability to organize objects into categories, by sorting and classifying objects using two or more attributes simultaneously (Sample problem: Sort a collection of buttons by size, colour, and number of holes.);
- 3m79** Collect data by conducting a simple survey about themselves, their environment, issues in their school or community, or content from another subject;
- 3m80** Collect and organize categorical or discrete primary data and display the data in charts, tables, and graphs (including vertical and horizontal bar graphs), with appropriate titles and labels and with labels ordered appropriately along horizontal axes, as needed, using many-to-one correspondence (e.g., in a pictograph, one car sticker represents 3 cars; on a bar graph, one square represents 2 students) (Sample problem: Graph data related to the eye colour of students in the class, using a vertical bar graph. Why does the scale on the vertical axis include values that are not in the set of data?);
- 3m81** Read primary data presented in charts, tables, and graphs (including vertical and horizontal bar graphs), then describe the data using comparative language, and describe the shape of the data (e.g., "Most of the data are at the high end."; "All of the data values are different.");
- 3m82** Interpret and draw conclusions from data presented in charts, tables, and graphs;
- 3m83** Demonstrate an understanding of mode (e.g., "The mode is the value that shows up most often on a graph."), and identify the mode in a set of data.
- 3m84** Predict the frequency of an outcome in a simple probability experiment or game (e.g., "I predict that an even number will come up 5 times and an odd number will come up 5 times when I roll a number cube 10 times."), then perform the experiment, and compare the results with the predictions, using mathematical language;
- 3m85** Demonstrate, through investigation, an understanding of fairness in a game and relate this to the occurrence of equally likely outcomes.

## **Mathematics (Grade 4 Expectations, 2005)**

#### **Mathematical Process Expectations**

- 4m1** Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
- 4m2** Develop and apply reasoning skills (e.g., classification, recognition of relationships, use of counter-examples) to make and investigate conjectures and construct and defend arguments;
- 4m3** Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by comparing and adjusting strategies used, by explaining why they think their results are reasonable, by recording their thinking in a math journal);
- 4m4** Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;
- 4m5** Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, sports);
- 4m6** Create a variety of representations of mathematical ideas (e.g., by using physical models, pictures, numbers, variables, diagrams, graphs, onscreen dynamic representations), make connections among them, and apply them to solve problems;
- 4m7** Communicate mathematical thinking orally, visually, and in writing, using everyday language, a basic mathematical vocabulary, and a variety of representations, and observing basic mathematical conventions.

#### **Number Sense and Numeration**

- 4m8** Read, represent, compare, and order whole numbers to 10 000, decimal numbers to tenths, and simple fractions, and represent money amounts to \$100;
- 4m9** Demonstrate an understanding of magnitude by counting forward and backwards by 0.1 and by fractional amounts;
- 4m10** Solve problems involving the addition, subtraction, multiplication, and division of single- and multi-digit whole numbers, and involving the addition and subtraction of decimal numbers to tenths and money amounts, using a variety of strategies;
- 4m11** Demonstrate an understanding of proportional reasoning by investigating whole-number unit rates;
- 4m12** Represent, compare, and order whole numbers to 10 000, using a variety of tools (e.g., drawings of base ten materials, number lines with increments of 100 or other appropriate amounts);
- 4m13** Demonstrate an understanding of place value in whole numbers and decimal numbers from 0.1 to 10 000, using a variety of tools and strategies (e.g., use base ten materials to represent 9307 as  $9000 + 300 + 0 + 7$ ) (Sample problem: Use the digits 1, 9, 5, 4 to create the greatest number and the least number possible, and explain your thinking.);
- 4m14** Read and print in words whole numbers to one thousand, using meaningful contexts (e.g., books, highway distance signs);
- 4m15** Round four-digit whole numbers to the nearest ten, hundred, and thousand, in problems arising from real-life situations;

- 4m16** Represent, compare, and order decimal numbers to tenths, using a variety of tools (e.g., concrete materials such as paper strips divided into tenths and base ten materials, number lines, drawings) and using standard decimal notation (Sample problem: Draw a partial number line that extends from 4.2 to 6.7, and mark the location of 5.6.);
- 4m17** Represent fractions using concrete materials, words, and standard fractional notation, and explain the meaning of the denominator as the number of the fractional parts of a whole or a set, and the numerator as the number of fractional parts being considered;
- 4m18** Compare and order fractions (i.e., halves, thirds, fourths, fifths, tenths) by considering the size and the number of fractional parts (e.g.,  $\frac{4}{5}$  is greater than  $\frac{3}{5}$  because there are more parts in  $\frac{4}{5}$ ;  $\frac{1}{4}$  is greater than  $\frac{1}{5}$  because the size of the part is larger in  $\frac{1}{4}$ );
- 4m19** Compare fractions to the benchmarks of 0,  $\frac{1}{2}$ , and 1 (e.g.,  $\frac{1}{8}$  is closer to 0 than to  $\frac{1}{2}$ ;  $\frac{3}{5}$  is more than  $\frac{1}{2}$ );
- 4m20** Demonstrate and explain the relationship between equivalent fractions, using concrete materials (e.g., fraction circles, fraction strips, pattern blocks) and drawings (e.g., "I can say that  $\frac{3}{6}$  of my cubes are white, or half of the cubes are white. This means that  $\frac{3}{6}$  and  $\frac{1}{2}$  are equal.");
- 4m21** Read and represent money amounts to \$100 (e.g., five dollars, two quarters, one nickel, and four cents is \$5.59);
- 4m22** Solve problems that arise from real-life situations and that relate to the magnitude of whole numbers up to 10 000 (Sample problem: How high would a stack of 10 000 pennies be? Justify your answer.);
- 4m23** Count forward by halves, thirds, fourths, and tenths to beyond one whole, using concrete materials and number lines (e.g., use fraction circles to count fourths: "One fourth, two fourths, three fourths, four fourths, five fourths, six fourths, ...");
- 4m24** Count forward by tenths from any decimal number expressed to one decimal place, using concrete materials and number lines (e.g., use base ten materials to represent 3.7 and count forward: 3.8, 3.9, 4.0, 4.1, ...; "Three and seven tenths, three and eight tenths, three and nine tenths, four, four and one tenth, ...") (Sample problem: What connections can you make between counting by tenths and measuring lengths in millimetres and in centimetres?);
- 4m25** Add and subtract two-digit numbers, using a variety of mental strategies (e.g., one way to calculate  $73 - 39$  is to subtract 40 from 73 to get 33, and then add 1 back to get 34);
- 4m26** Solve problems involving the addition and subtraction of four-digit numbers, using student-generated algorithms and standard algorithms (e.g., "I added  $4217 + 1914$  using  $5000 + 1100 + 20 + 11$ .");
- 4m27** Add and subtract decimal numbers to tenths, using concrete materials (e.g., paper strips divided into tenths, base ten materials) and student-generated algorithms (e.g., "When I added 6.5 and 5.6, I took five tenths in fraction circles and added six tenths in fraction circles to give me one whole and one tenth. Then I added  $6 + 5 + 1.1$ , which equals 12.1.");
- 4m28** Add and subtract money amounts by making simulated purchases and providing change for amounts up to \$100, using a variety of tools (e.g., currency manipulatives, drawings);
- 4m29** Multiply to  $9 \times 9$  and divide to  $81 \div 9$ , using a variety of mental strategies (e.g., doubles, doubles plus another set, skip counting);
- 4m30** Solve problems involving the multiplication of one-digit whole numbers, using a variety of mental strategies (e.g.,  $6 \times 8$  can be thought of as  $5 \times 8 + 1 \times 8$ );
- 4m31** Multiply whole numbers by 10, 100, and 1000, and divide whole numbers by 10 and 100, using mental strategies (e.g., use a calculator to look for patterns and generalize to develop a rule);
- 4m32** Multiply two-digit whole numbers by one-digit whole numbers, using a variety of tools (e.g., base ten materials or drawings of them, arrays), student-generated algorithms, and standard algorithms;
- 4m33** Divide two-digit whole numbers by one-digit whole numbers, using a variety of tools (e.g., concrete materials, drawings) and student-generated algorithms;
- 4m34** Use estimation when solving problems involving the addition, subtraction, and multiplication of whole numbers, to help judge the reasonableness of a solution (Sample problem: A school is ordering pencils that come in boxes of 100. If there are 9 classes and each class needs about 110 pencils, estimate how many boxes the school should buy.);
- 4m35** Describe relationships that involve simple whole-number multiplication (e.g., "If you have 2 marbles and I have 6 marbles, I can say that I have three times the number of marbles you have.");
- 4m36** Determine and explain, through investigation, the relationship between fractions (i.e., halves, fifths, tenths) and decimals to tenths, using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies (e.g., decompose into  $\frac{2}{5}$  into  $\frac{4}{10}$  by dividing each fifth into two equal parts to show that  $\frac{2}{5}$  can be represented as 0.4);
- 4m37** Demonstrate an understanding of simple multiplicative relationships involving unit rates, through investigation using concrete materials and drawings (e.g., scale drawings in which 1 cm represents 2 m) (Sample problem: If 1 book costs \$4, how do you determine the cost of 2 books?... 3 books?... 4 books?).

## Measurement

- 4m38** Estimate, measure, and record length, perimeter, area, mass, capacity, volume, and elapsed time, using a variety of strategies;
- 4m39** Determine the relationships among units and measurable attributes, including the area and perimeter of rectangles;
- 4m40** Estimate, measure, and record length, height, and distance, using standard units (i.e., millimetre, centimetre, metre, kilometre) (e.g., a pencil that is 75 mm long);
- 4m41** Draw items using a ruler, given specific lengths in millimetres or centimetres (Sample problem: Use estimation to draw a line that is 115 mm long. Beside it, use a ruler to draw a line that is 115 mm long. Compare the lengths of the lines.);
- 4m42** Estimate, measure (i.e., using an analogue clock), and represent time intervals to the nearest minute;
- 4m43** Estimate and determine elapsed time, with and without using a time line, given the durations of events expressed in five-minute intervals, hours, days, weeks, months, or years (Sample problem: If you wake up at 7:30 a.m., and it takes you 10 minutes to eat your breakfast, 5 minutes to brush your teeth, 25 minutes to wash and get dressed, 5 minutes to get your backpack ready, and 20 minutes to get to school, will you be at school by 9:00 a.m.?).
- 4m44** Estimate, measure using a variety of tools (e.g., centimetre grid paper, geoboard) and strategies, and record the perimeter and area of polygons;
- 4m45** Estimate, measure, and record the mass of objects (e.g., apple, baseball, book), using the standard units of the kilogram and the gram;
- 4m46** Estimate, measure, and record the capacity of containers (e.g., a drinking glass, a juice box), using the standard units of the litre and the millilitre;
- 4m47** Estimate, measure using concrete materials, and record volume, and relate volume to the space taken up by an object (e.g., use centimetre cubes to demonstrate how much space a rectangular prism takes up) (Sample problem: Build a rectangular prism using connecting cubes. Describe the volume of the prism using the number of connecting cubes.);
- 4m48** Describe, through investigation, the relationship between various units of length (i.e., millimetre, centimetre, decimetre, metre, kilometre);
- 4m49** Select and justify the most appropriate standard unit (i.e., millimetre, centimetre, decimetre, metre, kilometre) to measure the side lengths and perimeters of various polygons;
- 4m50** Determine, through investigation, the relationship between the side lengths of a rectangle and its perimeter and area (Sample problem: Create a variety of rectangles on a geoboard. Record the length, width, area, and perimeter of each rectangle on a chart. Identify relationships.);
- 4m51** Pose and solve meaningful problems that require the ability to distinguish perimeter and area (e.g., "I need to know about area when I cover a bulletin board with construction paper. I need to know about perimeter when I make the border.");
- 4m52** Compare and order a collection of objects, using standard units of mass (i.e., gram, kilogram) and/or capacity (i.e., millilitre, litre);

- 4m53** Determine, through investigation, the relationship between grams and kilograms (Sample problem: Use centimeter cubes with a mass of one gram, or other objects of known mass, to balance a one-kilogram mass.);
- 4m54** Determine, through investigation, the relationship between millilitres and litres (Sample problem: Use small containers of different known capacities to fill a one-litre container.);
- 4m55** Select and justify the most appropriate standard unit to measure mass (i.e., milligram, gram, kilogram) and the most appropriate standard unit to measure the capacity of a container (i.e., millilitre, litre);
- 4m56** Solve problems involving the relationship between years and decades, and between decades and centuries (Sample problem: How many decades old is Canada?);
- 4m57** Compare, using a variety of tools (e.g., geoboard, pattern blocks, dot paper), two-dimensional shapes that have the same perimeter or the same area (Sample problem: Draw, using grid paper, as many different rectangles with a perimeter of 10 units as you can make on a geoboard.).

### Geometry and Spatial Sense

- 4m58** Identify quadrilaterals and three-dimensional figures and classify them by their geometric properties, and compare various angles to benchmarks;
- 4m59** Construct three-dimensional figures, using two-dimensional shapes;
- 4m60** Identify and describe the location of an object, using a grid map, and reflect two-dimensional shapes;
- 4m61** Draw the lines of symmetry of two-dimensional shapes, through investigation using a variety of tools (e.g., Mira, grid paper) and strategies (e.g., paper folding) (Sample problem: Use paper folding to compare the symmetry of a rectangle with the symmetry of a square.);
- 4m62** Identify and compare different types of quadrilaterals (i.e., rectangle, square, trapezoid, parallelogram, rhombus) and sort and classify them by their geometric properties (e.g., sides of equal length; parallel sides; symmetry; number of right angles);
- 4m63** Identify benchmark angles (i.e., straight angle, right angle, half a right angle), using a reference tool (e.g., paper and fasteners, pattern blocks, straws), and compare other angles to these benchmarks (e.g., "The angle the door makes with the wall is smaller than a right angle but greater than half a right angle.") (Sample problem: Use paper folding to create benchmarks for a straight angle, a right angle, and half a right angle, and use these benchmarks to describe angles found in pattern blocks.);
- 4m64** Relate the names of the benchmark angles to their measures in degrees (e.g., a right angle is  $90^\circ$ );
- 4m65** Identify and describe prisms and pyramids, and classify them by their geometric properties (i.e., shape of faces, number of edges, number of vertices), using concrete materials.
- 4m66** Construct a three-dimensional figure from a picture or model of the figure, using connecting cubes (e.g., use connecting cubes to construct a rectangular prism);
- 4m67** Construct skeletons of three-dimensional figures, using a variety of tools (e.g., straws and modelling clay, toothpicks and marshmallows, Polydrons), and sketch the skeletons;
- 4m68** Draw and describe nets of rectangular and triangular prisms (Sample problem: Create as many different nets for a cube as you can, and share your results with a partner.);
- 4m69** Construct prisms and pyramids from given nets;
- 4m70** Construct three-dimensional figures (e.g., cube, tetrahedron), using only congruent shapes;
- 4m71** Identify and describe the general location of an object using a grid system (e.g., "The library is located at A3 on the map.");
- 4m72** Identify, perform, and describe reflections using a variety of tools (e.g., Mira, dot paper, technology);
- 4m73** Create and analyse symmetrical designs by reflecting a shape, or shapes, using a variety of tools (e.g., pattern blocks, Mira, geoboard, drawings), and identify the congruent shapes in the designs.

### Patterning and Algebra

- 4m74** Describe, extend, and create a variety of numeric and geometric patterns, make predictions related to the patterns, and investigate repeating patterns involving reflections;
- 4m75** Demonstrate an understanding of equality between pairs of expressions, using addition, subtraction, and multiplication;
- 4m76** Extend, describe, and create repeating, growing, and shrinking number patterns (e.g., "I created the pattern 1, 3, 4, 6, 7, 9, .... I started at 1, then added 2, then added 1, then added 2, then added 1, and I kept repeating this.");
- 4m77** Connect each term in a growing or shrinking pattern with its term number (e.g., in the sequence 1, 4, 7, 10, ..., the first term is 1, the second term is 4, the third term is 7, and so on), and record the patterns in a table of values that shows the term number and the term;
- 4m78** Create a number pattern involving addition, subtraction, or multiplication, given a pattern rule expressed in words (e.g., the pattern rule "start at 1 and multiply each term by 2 to get the next term" generates the sequence 1, 2, 4, 8, 16, 32, 64, ...);
- 4m79** Make predictions related to repeating geometric and numeric patterns (Sample problem: Create a pattern block train by alternating one green triangle with one red trapezoid. Predict which block will be in the 30th place.);
- 4m80** Extend and create repeating patterns that result from reflections, through investigation using a variety of tools (e.g., pattern blocks, dynamic geometry software, dot paper).
- 4m81** Determine, through investigation, the inverse relationship between multiplication and division (e.g., since  $4 \times 5 = 20$ , then  $20 \div 5 = 4$ ; since  $35 \div 5 = 7$ , then  $7 \times 5 = 35$ );
- 4m82** Determine the missing number in equations involving multiplication of one- and two-digit numbers, using a variety of tools and strategies (e.g., modelling with concrete materials, using guess and check with and without the aid of a calculator) (Sample problem: What is the missing number in the equation  $\_ \times 4 = 24$ ?);
- 4m83** Identify, through investigation (e.g., by using sets of objects in arrays, by drawing area models), and use the commutative property of multiplication to facilitate computation with whole numbers (e.g., "I know that  $15 \times 7 \times 2$  equals  $15 \times 2 \times 7$ . This is easier to multiply in my head because I get  $30 \times 7 = 210$ .");
- 4m84** Identify, through investigation (e.g., by using sets of objects in arrays, by drawing area models), and use the distributive property of multiplication over addition to facilitate computation with whole numbers (e.g., "I know that  $9 \times 52$  equals  $9 \times 50 + 9 \times 2$ . This is easier to calculate in my head because I get  $450 + 18 = 468$ .").

### Data Management and Probability

- 4m85** Collect and organize discrete primary data and display the data using charts and graphs, including stem-and-leaf plots and double bar graphs;
- 4m86** Read, describe, and interpret primary data and secondary data presented in charts and graphs, including stem-and-leaf plots and double bar graphs;
- 4m87** Predict the results of a simple probability experiment, then conduct the experiment and compare the prediction to the results.
- 4m88** Collect data by conducting a survey (e.g., "Choose your favourite meal from the following list: breakfast, lunch, dinner, other.") or an experiment to do with themselves, their environment, issues in their school or the community, or content from another subject, and record observations or measurements;

- 4m89** Collect and organize discrete primary data and display the data in charts, tables, and graphs (including stem-and-leaf plots and double bar graphs) that have appropriate titles, labels (e.g., appropriate units marked on the axes), and scales (e.g., with appropriate increments) that suit the range and distribution of the data, using a variety of tools (e.g., graph paper, simple spreadsheets, dynamic statistical software).
- 4m90** Read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., temperature data in the newspaper, data from the Internet about endangered species), presented in charts, tables, and graphs (including stem-and-leaf plots and double bar graphs);
- 4m91** Demonstrate, through investigation, an understanding of median (e.g., "The median is the value in the middle of the data. If there are two middle values, you have to calculate the middle of those two values."), and determine the median of a set of data (e.g., "I used a stem-and-leaf plot to help me find the median.");
- 4m92** Describe the shape of a set of data across its range of values, using charts, tables, and graphs (e.g. "The data values are spread out evenly."; "The set of data bunches up around the median.");
- 4m93** Compare similarities and differences between two related sets of data, using a variety of strategies (e.g., by representing the data using tally charts, stem-and-leaf plots, or double bar graphs; by determining the mode or the median; by describing the shape of a data set across its range of values);
- 4m94** Predict the frequency of an outcome in a simple probability experiment, explaining their reasoning; conduct the experiment; and compare the result with the prediction (Sample problem: If you toss a pair of number cubes 20 times and calculate the sum for each toss, how many times would you expect to get 12? 7? 1? Explain your thinking. Then conduct the experiment and compare the results with your predictions.);
- 4m95** Determine, through investigation, how the number of repetitions of a probability experiment can affect the conclusions drawn (Sample problem: Each student in the class tosses a coin 10 times and records how many times tails comes up. Combine the individual student results to determine a class result, and then compare the individual student results and the class result.).

## Mathematics (Grade 5 Expectations, 2005)

### Mathematical Process Expectations

- 5m1** Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
- 5m2** Develop and apply reasoning skills (e.g., classification, recognition of relationships, use of counter-examples) to make and investigate conjectures and construct and defend arguments;
- 5m3** Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by comparing and adjusting strategies used, by explaining why they think their results are reasonable, by recording their thinking in a math journal);
- 5m4** Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;
- 5m5** Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, sports);
- 5m6** Create a variety of representations of mathematical ideas (e.g., by using physical models, pictures, numbers, variables, diagrams, graphs, onscreen dynamic representations), make connections among them, and apply them to solve problems;
- 5m7** Communicate mathematical thinking orally, visually, and in writing, using everyday language, a basic mathematical vocabulary, and a variety of representations, and observing basic mathematical conventions.

### Number Sense and Numeration

- 5m8** *Read, represent, compare, and order whole numbers to 100 000, decimal numbers to hundredths, proper and improper fractions, and mixed numbers;*
- 5m9** *Demonstrate an understanding of magnitude by counting forward and backwards by 0.01;*
- 5m10** *Solve problems involving the multiplication and division of multi-digit whole numbers, and involving the addition and subtraction of decimal numbers to hundredths, using a variety of strategies;*
- 5m11** *Demonstrate an understanding of proportional reasoning by investigating whole-number rates;*
- 5m12** Represent, compare, and order whole numbers and decimal numbers from 0.01 to 100 000, using a variety of tools (e.g., number lines with appropriate increments, base ten materials for decimals);
- 5m13** Demonstrate an understanding of place value in whole numbers and decimal numbers from 0.01 to 100 000, using a variety of tools and strategies (e.g., use numbers to represent 23 011 as  $20\ 000 + 3000 + 0 + 10 + 1$ ; use base ten materials to represent the relationship between 1, 0.1, and 0.01) (Sample problem: How many thousands cubes would be needed to make a base ten block for 100 000?);
- 5m14** Read and print in words whole numbers to ten thousand, using meaningful contexts (e.g., newspapers, magazines);
- 5m15** Round decimal numbers to the nearest tenth, in problems arising from real-life situations;
- 5m16** Represent, compare, and order fractional amounts with like denominators, including proper and improper fractions and mixed numbers, using a variety of tools (e.g., fraction circles, Cuisenaire rods, number lines) and using standard fractional notation;
- 5m17** Demonstrate and explain the concept of equivalent fractions, using concrete materials (e.g., use fraction strips to show that  $\frac{1}{2}$  is equal to  $\frac{3}{4}$   $\frac{9}{12}$ );
- 5m18** Demonstrate and explain equivalent representations of a decimal number, using concrete materials and drawings (e.g., use base ten materials to show that three tenths [0.3] is equal to thirty hundredths [0.30]);
- 5m19** Read and write money amounts to \$1000 (e.g., \$455.35 is 455 dollars and 35 cents, or four hundred fifty-five dollars and thirty-five cents);
- 5m20** Solve problems that arise from real-life situations and that relate to the magnitude of whole numbers up to 100 000 (Sample problem: How many boxes hold 100 000 sheets of paper, if one box holds 8 packages of paper, and one package of paper contains 500 sheets of paper?);
- 5m21** Count forward by hundredths from any decimal number expressed to two decimal places, using concrete materials and number lines (e.g., use base ten materials to represent 2.96 and count forward by hundredths: 2.97, 2.98, 2.99, 3.00, 3.01, ...; "Two and ninety-six hundredths, two and ninety-seven hundredths, two and ninety-eight hundredths, two and ninety-nine hundredths, three, three and one hundredth, ...") (Sample problem: What connections can you make between counting by hundredths and measuring lengths in centimetres and metres?);
- 5m22** Solve problems involving the addition, subtraction, and multiplication of whole numbers, using a variety of mental strategies (e.g., use the commutative property:  $5 \times 18 \times 2 = 5 \times 2 \times 18$ , which gives  $10 \times 18 = 180$ );
- 5m23** Add and subtract decimal numbers to hundredths, including money amounts, using concrete materials, estimation, and algorithms (e.g., use 10 x 10 grids to add 2.45 and 3.25);
- 5m24** Multiply two-digit whole numbers by two-digit whole numbers, using estimation, student-generated algorithms, and standard algorithms;
- 5m25** Divide three-digit whole numbers by one-digit whole numbers, using concrete materials, estimation, student-generated algorithms, and standard algorithms;

- 5m26** Multiply decimal numbers by 10, 100, 1000, and 10 000, and divide decimal numbers by 10 and 100, using mental strategies (e.g., use a calculator to look for patterns and generalize to develop a rule);
- 5m27** Use estimation when solving problems involving the addition, subtraction, multiplication, and division of whole numbers, to help judge the reasonableness of a solution (Sample problem: Mori used a calculator to add 7.45 and 2.39. The calculator display showed 31.35. Explain why this result is not reasonable, and suggest where you think Mori made his mistake.);
- 5m28** Describe multiplicative relationships between quantities by using simple fractions and decimals (e.g., "If you have 4 plums and I have 6 plums, I can say that I have  $1\frac{1}{2}$  or 1.5 times as many plums as you have.");
- 5m29** Determine and explain, through investigation using concrete materials, drawings, and calculators, the relationship between fractions (i.e., with denominators of 2, 4, 5, 10, 20, 25, 50, and 100) and their equivalent decimal forms (e.g., use a 10 x 10 grid to show that  $\frac{2}{5} = \frac{40}{100}$ , which can also be represented as 0.4);
- 5m30** Demonstrate an understanding of simple multiplicative relationships involving whole-number rates, through investigation using concrete materials and drawings (Sample problem: If 2 books cost \$6, how would you calculate the cost of 8 books?).

### Measurement

- 5m31** Estimate, measure, and record perimeter, area, temperature change, and elapsed time, using a variety of strategies;
- 5m32** Determine the relationships among units and measurable attributes, including the area of a rectangle and the volume of a rectangular prism.
- 5m33** Estimate, measure (i.e., using an analogue clock), and represent time intervals to the nearest second;
- 5m34** Estimate and determine elapsed time, with and without using a time line, given the durations of events expressed in minutes, hours, days, weeks, months, or years (Sample problem: You are travelling from Toronto to Montreal by train. If the train departs Toronto at 11:30 a.m. and arrives in Montreal at 4:56 p.m., how long will you be on the train?);
- 5m35** Measure and record temperatures to determine and represent temperature changes over time (e.g., record temperature changes in an experiment or over a season) (Sample problem: Investigate the relationship between weather, climate, and temperature changes over time in different locations.);
- 5m36** Estimate and measure the perimeter and area of regular and irregular polygons, using a variety of tools (e.g., grid paper, geoboard, dynamic geometry software) and strategies.
- 5m37** Select and justify the most appropriate standard unit (i.e., millimetre, centimetre, decimetre, metre, kilometre) to measure length, height, width, and distance, and to measure the perimeter of various polygons;
- 5m38** Solve problems requiring conversion from metres to centimetres and from kilometres to metres (Sample problem: Describe the multiplicative relationship between the number of centimetres and the number of metres that represent a length. Use this relationship to convert 5.1 m to centimetres.);
- 5m39** Solve problems involving the relationship between a 12-hour clock and a 24-hour clock (e.g., 15:00 is 3 hours after 12 noon, so 15:00 is the same as 3:00 p.m.);
- 5m40** Create, through investigation using a variety of tools (e.g., pattern blocks, geoboard, grid paper) and strategies, two-dimensional shapes with the same perimeter or the same area (e.g., rectangles and parallelograms with the same base and the same height) (Sample problem: Using dot paper, how many different rectangles can you draw with a perimeter of 12 units? with an area of 12 square units?);
- 5m41** Determine, through investigation using a variety of tools (e.g., concrete materials, dynamic geometry software, grid paper) and strategies (e.g., building arrays), the relationships between the length and width of a rectangle and its area and perimeter, and generalize to develop the formulas [i.e., Area = length x width; Perimeter = (2 x length) + (2 x width)];
- 5m42** Solve problems requiring the estimation and calculation of perimeters and areas of rectangles (Sample problem: You are helping to fold towels, and you want them to stack nicely. By folding across the length and/or the width, you fold each towel a total of three times. You want the shape of each folded towel to be as close to a square as possible. Does it matter how you fold the towels?);
- 5m43** Determine, through investigation, the relationship between capacity (i.e., the amount a container can hold) and volume (i.e., the amount of space taken up by an object), by comparing the volume of an object with the amount of liquid it can contain or displace (e.g., a bottle has a volume, the space it takes up, and a capacity, the amount of liquid it can hold) (Sample problem: Compare the volume and capacity of a thin-walled container in the shape of a rectangular prism to determine the relationship between units for measuring capacity [e.g., millilitres] and units for measuring volume [e.g., cubic centimetres].);
- 5m44** Determine, through investigation using stacked congruent rectangular layers of concrete materials, the relationship between the height, the area of the base, and the volume of a rectangular prism, and generalize to develop the formula (i.e., Volume = area of base x height) (Sample problem: Create a variety of rectangular prisms using connecting cubes. For each rectangular prism, record the area of the base, the height, and the volume on a chart. Identify relationships.);
- 5m45** Select and justify the most appropriate standard unit to measure mass (i.e., milligram, gram, kilogram, tonne).

### Geometry and Spatial Sense

- 5m46** Identify and classify two-dimensional shapes by side and angle properties, and compare and sort three-dimensional figures;
- 5m47** Identify and construct nets of prisms and pyramids;
- 5m48** Identify and describe the location of an object, using the cardinal directions, and translate two-dimensional shapes;
- 5m49** Distinguish among polygons, regular polygons, and other two-dimensional shapes;
- 5m50** Distinguish among prisms, right prisms, pyramids, and other three-dimensional figures;
- 5m51** Identify and classify acute, right, obtuse, and straight angles;
- 5m52** Measure and construct angles up to 90°, using a protractor;
- 5m53** Identify triangles (i.e., acute, right, obtuse, scalene, isosceles, equilateral), and classify them according to angle and side properties;
- 5m54** Construct triangles, using a variety of tools (e.g., protractor, compass, dynamic geometry software), given acute or right angles and side measurements (Sample problem: Use a protractor, ruler, and pencil to construct a scalene triangle with a 30° angle and a side measuring 12 cm.);
- 5m55** Identify prisms and pyramids from their nets;
- 5m56** Construct nets of prisms and pyramids, using a variety of tools (e.g., grid paper, isometric dot paper, Polydrons, computer application);
- 5m57** Locate an object using the cardinal directions (i.e., north, south, east, west) and a coordinate system (e.g., "If I walk 5 steps north and 3 steps east, I will arrive at the apple tree.");
- 5m58** Compare grid systems commonly used on maps (i.e., the use of numbers and letters to identify an area; the use of a coordinate system based on the cardinal directions to describe a specific location);
- 5m59** Identify, perform, and describe translations, using a variety of tools (e.g., geoboard, dot paper, computer program);
- 5m60** Create and analyse designs by translating and/or reflecting a shape, or shapes, using a variety of tools (e.g., geoboard, grid paper, computer program) (Sample problem: Identify translations and/or reflections that map congruent shapes onto each other in a given design.).

### Patterning and Algebra

- 5m61** Determine, through investigation using a table of values, relationships in growing and shrinking patterns, and investigate repeating patterns involving translations;
- 5m62** Demonstrate, through investigation, an understanding of the use of variables in equations;
- 5m63** Create, identify, and extend numeric and geometric patterns, using a variety of tools (e.g., concrete materials, paper and pencil, calculators, spreadsheets);
- 5m64** Build a model to represent a number pattern presented in a table of values that shows the term number and the term;
- 5m65** Make a table of values for a pattern that is generated by adding or subtracting a number (i.e., a constant) to get the next term, or by multiplying or dividing by a constant to get the next term, given either the sequence (e.g., 12, 17, 22, 27, 32, ...) or the pattern rule in words (e.g., start with 12 and add 5 to each term to get the next term);
- 5m66** Make predictions related to growing and shrinking geometric and numeric patterns (Sample problem: Create growing L's using tiles. The first L has 3 tiles, the second L has 5 tiles, the third L has 7 tiles, and so on. Predict the number of tiles you would need to build the 10th L in the pattern.);
- 5m67** Extend and create repeating patterns that result from translations, through investigation using a variety of tools (e.g., pattern blocks, dynamic geometry software, dot paper).
- 5m68** Demonstrate, through investigation, an understanding of variables as changing quantities, given equations with letters or other symbols that describe relationships involving simple rates (e.g., the equations  $C = 3 \times n$  and  $3 \times n = C$  both represent the relationship between the total cost (C), in dollars, and the number of sandwiches purchased (n), when each sandwich costs \$3);
- 5m69** Demonstrate, through investigation, an understanding of variables as unknown quantities represented by a letter or other symbol (e.g.,  $12 = 5 + \_$  or  $12 = 5 + s$  can be used to represent the following situation: "I have 12 stamps altogether and 5 of them are from Canada. How many are from other countries?");
- 5m70** Determine the missing number in equations involving addition, subtraction, multiplication, or division and one- or two-digit numbers, using a variety of tools and strategies (e.g., modelling with concrete materials, using guess and check with and without the aid of a calculator) (Sample problem: What is the missing number in the equation  $8 = 88 \div \_?$ ).

### **Data Management and Probability**

- 5m71** Collect and organize discrete or continuous primary data and secondary data and display the data using charts and graphs, including broken-line graphs;
- 5m72** Read, describe, and interpret primary data and secondary data presented in charts and graphs, including broken-line graphs;
- 5m73** Represent as a fraction the probability that a specific outcome will occur in a simple probability experiment, using systematic lists and area models.
- 5m74** Distinguish between discrete data (i.e., data organized using numbers that have gaps between them, such as whole numbers, and often used to represent a count, such as the number of times a word is used) and continuous data (i.e., data organized using all numbers on a number line that fall within the range of the data, and used to represent measurements such as heights or ages of trees);
- 5m75** Collect data by conducting a survey or an experiment (e.g., gather and record air temperature over a two-week period) to do with themselves, their environment, issues in their school or community, or content from another subject, and record observations or measurements;
- 5m76** Collect and organize discrete or continuous primary data and secondary data and display the data in charts, tables, and graphs (including broken-line graphs) that have appropriate titles, labels (e.g., appropriate units marked on the axes), and scales that suit the range and distribution of the data (e.g., to represent precipitation amounts ranging from 0 mm to 50 mm over the school year, use a scale of 5 mm for each unit on the vertical axis and show months on the horizontal axis), using a variety of tools (e.g., graph paper, simple spreadsheets, dynamic statistical software);
- 5m77** Demonstrate an understanding that sets of data can be samples of larger populations (e.g., to determine the most common shoe size in your class, you would include every member of the class in the data; to determine the most common shoe size in Ontario for your age group, you might collect a large sample from classes across the province);
- 5m78** Describe, through investigation, how a set of data is collected (e.g., by survey, measurement, observation) and explain whether the collection method is appropriate;
- 5m79** Read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., precipitation or temperature data in the newspaper, data from the Internet about heights of buildings and other structures), presented in charts, tables, and graphs (including broken-line graphs);
- 5m80** Calculate the mean for a small set of data and use it to describe the shape of the data set across its range of values, using charts, tables, and graphs (e.g., "The data values fall mainly into two groups on both sides of the mean."; "The set of data is not spread out evenly around the mean.");
- 5m81** Compare similarities and differences between two related sets of data, using a variety of strategies (e.g., by representing the data using tally charts, stem-and-leaf plots, double bar graphs, or broken-line graphs; by determining measures of central tendency [i.e., mean, median, and mode]; by describing the shape of a data set across its range of values).
- 5m82** Determine and represent all the possible outcomes in a simple probability experiment (e.g., when tossing a coin, the possible outcomes are heads and tails; when rolling a number cube, the possible outcomes are 1, 2, 3, 4, 5, and 6), using systematic lists and area models (e.g., a rectangle is divided into two equal areas to represent the outcomes of a coin toss experiment);
- 5m83** Represent, using a common fraction, the probability that an event will occur in simple games and probability experiments (e.g., "My spinner has four equal sections and one of those sections is coloured red. The probability that I will land on red is  $\frac{1}{4}$ .");
- 5m84** Pose and solve simple probability problems, and solve them by conducting probability experiments and selecting appropriate methods of recording the results (e.g., tally chart, line plot, bar graph).

## **Mathematics (Grade 6 Expectations, 2005)**

### **Mathematical Process Expectations**

- 6m1** Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
- 6m2** Develop and apply reasoning skills (e.g., classification, recognition of relationships, use of counter-examples) to make and investigate conjectures and construct and defend arguments;
- 6m3** Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by comparing and adjusting strategies used, by explaining why they think their results are reasonable, by recording their thinking in a math journal);
- 6m4** Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;

- 6m5** Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, sports);
- 6m6** Create a variety of representations of mathematical ideas (e.g., by using physical models, pictures, numbers, variables, diagrams, graphs, onscreen dynamic representations), make connections among them, and apply them to solve problems;
- 6m7** Communicate mathematical thinking orally, visually, and in writing, using everyday language, a basic mathematical vocabulary, and a variety of representations, and observing basic mathematical conventions.

### **Number Sense and Numeration**

- 6m8** *Read, represent, compare, and order whole numbers to 1 000 000, decimal numbers to thousandths, proper and improper fractions, and mixed numbers;*
- 6m9** *Solve problems involving the multiplication and division of whole numbers, and the addition and subtraction of decimal numbers to thousandths, using a variety of strategies;*
- 6m10** *Demonstrate an understanding of relationships involving percent, ratio, and unit rate;*
- 6m11** Represent, compare, and order whole numbers and decimal numbers from 0.001 to 1 000 000, using a variety of tools (e.g., number lines with appropriate increments, base ten materials for decimals);
- 6m12** Demonstrate an understanding of place value in whole numbers and decimal numbers from 0.001 to 1 000 000, using a variety of tools and strategies (e.g. use base ten materials to represent the relationship between 1, 0.1, 0.01, and 0.001) (Sample problem: How many thousands cubes would be needed to make a base ten block for 1 000 000?);
- 6m13** Read and print in words whole numbers to one hundred thousand, using meaningful contexts (e.g., the Internet, reference books);
- 6m14** Represent, compare, and order fractional amounts with unlike denominators, including proper and improper fractions and mixed numbers, using a variety of tools (e.g., fraction circles, Cuisenaire rods, drawings, number lines, calculators) and using standard fractional notation (Sample problem: Use fraction strips to show that  $1\frac{1}{2}$  is greater than  $\frac{5}{4}$ .);
- 6m15** Estimate quantities using benchmarks of 10%, 25%, 50%, 75%, and 100% (e.g., the container is about 75% full; approximately 50% of our students walk to school);
- 6m16** Solve problems that arise from real-life situations and that relate to the magnitude of whole numbers up to 1 000 000 (Sample problem: How would you determine if a person could live to be 1 000 000 hours old? Show your work.);
- 6m17** Identify composite numbers and prime numbers, and explain the relationship between them (i.e., any composite number can be factored into prime factors) (e.g.,  $42 = 2 \times 3 \times 7$ );
- 6m18** Use a variety of mental strategies to solve addition, subtraction, multiplication, and division problems involving whole numbers (e.g., use the commutative property:  $4 \times 16 \times 5 = 4 \times 5 \times 16$ , which gives  $20 \times 16 = 320$ ; use the distributive property:  $(500 + 15) \div 5 = 500 \div 5 + 15 \div 5$ , which gives  $100 + 3 = 103$ );
- 6m19** Solve problems involving the multiplication and division of whole numbers (four-digit by two-digit), using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies (e.g., estimation, algorithms);
- 6m20** Add and subtract decimal numbers to thousandths, using concrete materials, estimation, algorithms, and calculators;
- 6m21** Multiply and divide decimal numbers to tenths by whole numbers, using concrete materials, estimation, algorithms, and calculators (e.g., calculate  $4 \times 1.4$  using base ten materials; calculate  $5.6 \div 4$  using base ten materials);
- 6m22** Multiply whole numbers by 0.1, 0.01, and 0.001 using mental strategies (e.g., use a calculator to look for patterns and generalize to develop a rule);
- 6m23** Multiply and divide decimal numbers by 10, 100, 1000, and 10 000 using mental strategies (e.g., "To convert 0.6 m<sup>2</sup> to square centimetres, I calculated in my head  $0.6 \times 10\ 000$  and got 6000 cm<sup>2</sup>.") (Sample problem: Use a calculator to help you generalize a rule for multiplying numbers by 10 000.);
- 6m24** Use estimation when solving problems involving the addition and subtraction of whole numbers and decimals, to help judge the reasonableness of a solution;
- 6m25** Explain the need for a standard order for performing operations, by investigating the impact that changing the order has when performing a series of operations (Sample problem: Calculate and compare the answers to  $3 + 2 \times 5$  using a basic four-function calculator and using a scientific calculator.);
- 6m26** Represent ratios found in real-life contexts, using concrete materials, drawings, and standard fractional notation (Sample problem: In a classroom of 28 students, 12 are female. What is the ratio of male students to female students?);
- 6m27** Determine and explain, through investigation using concrete materials, drawings, and calculators, the relationships among fractions (i.e., with denominators of 2, 4, 5, 10, 20, 25, 50, and 100), decimal numbers, and percents (e.g., use a 10 x 10 grid to show that  $\frac{1}{4} = 0.25$  or 25%);
- 6m28** Represent relationships using unit rates (Sample problem: If 5 batteries cost \$4.75, what is the cost of 1 battery?).

### **Measurement**

- 6m29** *Estimate, measure, and record quantities, using the metric measurement system;*
- 6m30** *Determine the relationships among units and measurable attributes, including the area of a parallelogram, the area of a triangle, and the volume of a triangular prism.*
- 6m31** Demonstrate an understanding of the relationship between estimated and precise measurements, and determine and justify when each kind is appropriate (Sample problem: You are asked how long it takes you to travel a given distance. How is the method you use to determine the time related to the precision of the measurement?);
- 6m32** Estimate, measure, and record length, area, mass, capacity, and volume, using the metric measurement system;
- 6m33** Select and justify the appropriate metric unit (i.e., millimetre, centimetre, decimetre, metre, decametre, kilometre) to measure length or distance in a given real-life situation (Sample problem: Select and justify the unit that should be used to measure the perimeter of the school.);
- 6m34** Solve problems requiring conversion from larger to smaller metric units (e.g., metres to centimetres, kilograms to grams, litres to millilitres) (Sample problem: How many grams are in one serving if 1.5 kg will serve six people?);
- 6m35** Construct a rectangle, a square, a triangle, and a parallelogram, using a variety of tools (e.g., concrete materials, geoboard, dynamic geometry software, grid paper), given the area and/or perimeter (Sample problem: Create two different triangles with an area of 12 square units, using a geoboard.);
- 6m36** Determine, through investigation using a variety of tools (e.g., pattern blocks, Power Polygons, dynamic geometry software, grid paper) and strategies (e.g., paper folding, cutting, and rearranging), the relationship between the area of a rectangle and the areas of parallelograms and triangles, by decomposing (e.g., cutting up a parallelogram into a rectangle and two congruent triangles) and composing (e.g., combining two congruent triangles to form a parallelogram) (Sample problem: Decompose a rectangle and rearrange the parts to compose a parallelogram with the same area. Decompose a parallelogram into two congruent triangles, and compare the area of one of the triangles with the area of the parallelogram.);

- 6m37** Develop the formulas for the area of a parallelogram (i.e., Area of parallelogram = base x height) and the area of a triangle [i.e., Area of triangle = (base x height) ÷ 2], using the area relationships among rectangles, parallelograms, and triangles (Sample problem: Use dynamic geometry software to show that parallelograms with the same height and the same base all have the same area.);
- 6m38** Solve problems involving the estimation and calculation of the areas of triangles and the areas of parallelograms (Sample problem: Calculate the areas of parallelograms that share the same base and the same height, including the special case where the parallelogram is a rectangle.);
- 6m39** Determine, using concrete materials, the relationship between units used to measure area (i.e., square centimetre, square metre), and apply the relationship to solve problems that involve conversions from square metres to square centimetres (Sample problem: Describe the multiplicative relationship between the number of square centimetres and the number of square metres that represent an area. Use this relationship to determine how many square centimetres fit into half a square metre.);
- 6m40** Determine, through investigation using a variety of tools and strategies (e.g., decomposing rectangular prisms into triangular prisms; stacking congruent triangular layers of concrete materials to form a triangular prism), the relationship between the height, the area of the base, and the volume of a triangular prism, and generalize to develop the formula (i.e., Volume = area of base x height) (Sample problem: Create triangular prisms by splitting rectangular prisms in half. For each prism, record the area of the base, the height, and the volume on a chart. Identify relationships.);
- 6m41** Determine, through investigation using a variety of tools (e.g., nets, concrete materials, dynamic geometry software, Polydrons) and strategies, the surface area of rectangular and triangular prisms;
- 6m42** Solve problems involving the estimation and calculation of the surface area and volume of triangular and rectangular prisms (Sample problem: How many square centimetres of wrapping paper are required to wrap a box that is 10 cm long, 8 cm wide, and 12 cm high?).

### Geometry and Spatial Sense

- 6m43** Classify and construct polygons and angles;
- 6m44** Sketch three-dimensional figures, and construct three-dimensional figures from drawings;
- 6m45** Describe location in the first quadrant of a coordinate system, and rotate two-dimensional shapes;
- 6m46** Sort and classify quadrilaterals by geometric properties related to symmetry, angles, and sides, through investigation using a variety of tools (e.g., geoboard, dynamic geometry software) and strategies (e.g., using charts, using Venn diagrams);
- 6m47** Sort polygons according to the number of lines of symmetry and the order of rotational symmetry, through investigation using a variety of tools (e.g., tracing paper, dynamic geometry software, Mira);
- 6m48** Measure and construct angles up to 180° using a protractor, and classify them as acute, right, obtuse, or straight angles;
- 6m49** Construct polygons using a variety of tools, given angle and side measurements (Sample problem: Use dynamic geometry software to construct trapezoids with a 45° angle and a side measuring 11 cm.);
- 6m50** Build three-dimensional models using connecting cubes, given isometric sketches or different views (i.e., top, side, front) of the structure (Sample problem: Given the top, side, and front views of a structure, build it using the smallest number of cubes possible.);
- 6m51** Sketch, using a variety of tools (e.g., isometric dot paper, dynamic geometry software), isometric perspectives and different views (i.e., top, side, front) of three-dimensional figures built with interlocking cubes;
- 6m52** Explain how a coordinate system represents location, and plot points in the first quadrant of a Cartesian coordinate plane;
- 6m53** Identify, perform, and describe, through investigation using a variety of tools (e.g., grid paper, tissue paper, protractor, computer technology), rotations of 180° and clockwise and counterclockwise rotations of 90°, with the centre of rotation inside or outside the shape;
- 6m54** Create and analyse designs made by reflecting, translating, and/or rotating a shape, or shapes, by 90° or 180° (Sample problem: Identify rotations of 90° or 180° that map congruent shapes, in a given design, onto each other.).

### Patterning and Algebra

- 6m55** Describe and represent relationships in growing and shrinking patterns (where the terms are whole numbers), and investigate repeating patterns involving rotations;
- 6m56** Use variables in simple algebraic expressions and equations to describe relationships;
- 6m57** Identify geometric patterns, through investigation using concrete materials or drawings, and represent them numerically;
- 6m58** Make tables of values, for growing patterns given pattern rules, in words (e.g., start with 3, then double each term and add 1 to get the next term), then list the ordered pairs (with the first coordinate representing the term number and the second coordinate representing the term) and plot the points in the first quadrant, using a variety of tools (e.g., graph paper, calculators, dynamic statistical software);
- 6m59** Determine the term number of a given term in a growing pattern that is represented by a pattern rule in words, a table of values, or a graph (Sample problem: For the pattern rule "start with 1 and add 3 to each term to get the next term", use graphing to find the term number when the term is 19.);
- 6m60** Describe pattern rules (in words) that generate patterns by adding or subtracting a constant, or multiplying or dividing by a constant, to get the next term (e.g., for 1, 3, 5, 7, 9, ..., the pattern rule is "start with 1 and add 2 to each term to get the next term"), then distinguish such pattern rules from pattern rules, given in words, that describe the general term by referring to the term number (e.g., for 2, 4, 6, 8, ..., the pattern rule for the general term is "double the term number");
- 6m61** Determine a term, given its term number, by extending growing and shrinking patterns that are generated by adding or subtracting a constant, or multiplying or dividing by a constant, to get the next term (Sample problem: For the pattern 5000, 4750, 4500, 4250, 4000, 3750, ..., find the 15th term. Explain your reasoning.);
- 6m62** Extend and create repeating patterns that result from rotations, through investigation using a variety of tools (e.g., pattern blocks, dynamic geometry software, geoboards, dot paper);
- 6m63** Demonstrate an understanding of different ways in which variables are used (e.g., variable as an unknown quantity; variable as a changing quantity);
- 6m64** Identify, through investigation, the quantities in an equation that vary and those that remain constant (e.g., in the formula for the area of a triangle,  $A = (bxh)/2$ , the number 2 is a constant, whereas b and h can vary and may change the value of A);
- 6m65** Solve problems that use two or three symbols or letters as variables to represent different unknown quantities (Sample problem: If  $n + l = 15$  and  $n + l + s = 19$ , what value does the s represent?);
- 6m66** Determine the solution to a simple equation with one variable, through investigation using a variety of tools and strategies (e.g., modelling with concrete materials, using guess and check with and without the aid of a calculator) (Sample problem: Use the method of your choice to determine the value of the variable in the equation  $2x + 3 = 11$ . Is there more than one possible solution? Explain your reasoning.).

### Data Management and Probability

- 6m67** Collect and organize discrete or continuous primary data and secondary data and display the data using charts and graphs, including continuous line graphs;
- 6m68** Read, describe, and interpret data, and explain relationships between sets of data;

- 6m69** Determine the theoretical probability of an outcome in a probability experiment, and use it to predict the frequency of the outcome.
- 6m70** Collect data by conducting a survey (e.g., use an Internet survey tool) or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject, and record observations or measurements;
- 6m71** Collect and organize discrete or continuous primary data and secondary data (e.g., electronic data from websites such as E-Stat or Census At Schools) and display the data in charts, tables, and graphs (including continuous line graphs) that have appropriate titles, labels (e.g., appropriate units marked on the axes), and scales (e.g., with appropriate increments) that suit the range and distribution of the data, using a variety of tools (e.g., graph paper, spreadsheets, dynamic statistical software);
- 6m72** Select an appropriate type of graph to represent a set of data, graph the data using technology, and justify the choice of graph (i.e., from types of graphs already studied, such as pictographs, horizontal or vertical bar graphs, stem-and-leaf plots, double bar graphs, broken-line graphs, and continuous line graphs);
- 6m73** Determine, through investigation, how well a set of data represents a population, on the basis of the method that was used to collect the data (Sample problem: Would the results of a survey of primary students about their favourite television shows represent the favourite shows of students in the entire school? Why or why not?);
- 6m74** Read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., sports data in the newspaper, data from the Internet about movies), presented in charts, tables, and graphs (including continuous line graphs);
- 6m75** Compare, through investigation, different graphical representations of the same data (Sample problem: Use technology to help you compare the different types of graphs that can be created to represent a set of data about the number of runs or goals scored against each team in a tournament. Describe the similarities and differences that you observe.);
- 6m76** Explain how different scales used on graphs can influence conclusions drawn from the data;
- 6m77** Demonstrate an understanding of mean (e.g., mean differs from median and mode because it is a value that "balances" a set of data – like the centre point or fulcrum in a lever), and use the mean to compare two sets of related data, with and without the use of technology (Sample problem: Use the mean to compare the masses of backpacks of students from two or more Grade 6 classes.);
- 6m78** Demonstrate, through investigation, an understanding of how data from charts, tables, and graphs can be used to make inferences and convincing arguments (e.g., describe examples found in newspapers and magazines).
- 6m79** Express theoretical probability as a ratio of the number of favourable outcomes to the total number of possible outcomes, where all outcomes are equally likely (e.g., the theoretical probability of rolling an odd number on a six-sided number cube is  $\frac{3}{6}$  because, of six equally likely outcomes, only three are favourable – that is, the odd numbers 1, 3, 5);
- 6m80** Represent the probability of an event (i.e., the likelihood that the event will occur), using a value from the range of 0 (never happens or impossible) to 1 (always happens or certain);
- 6m81** Predict the frequency of an outcome of a simple probability experiment or game, by calculating and using the theoretical probability of that outcome (e.g., "The theoretical probability of spinning red is  $\frac{1}{4}$  since there are four different-coloured areas that are equal. If I spin my spinner 100 times, I predict that red should come up about 25 times."). (Sample problem: Create a spinner that has rotational symmetry. Predict how often the spinner will land on the same sector after 25 spins. Perform the experiment and compare the prediction to the results.).

## Mathematics (Grade 7 Expectations, 2005)

### Mathematical Process Expectations

- 7m1** Develop, select, apply, and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
- 7m2** Develop and apply reasoning skills (e.g., recognition of relationships, generalization through inductive reasoning, use of counter-examples) to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments;
- 7m3** Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by assessing the effectiveness of strategies and processes used, by proposing alternative approaches, by judging the reasonableness of results, by verifying solutions);
- 7m4** Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;
- 7m5** Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, current events, art and culture, sports);
- 7m6** Create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;
- 7m7** Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

### Number Sense and Numeration

- 7n8** Represent, compare, and order numbers, including integers;
- 7n9** Demonstrate an understanding of addition and subtraction of fractions and integers, and apply a variety of computational strategies to solve problems involving whole numbers and decimal numbers;
- 7n10** Demonstrate an understanding of proportional relationships using percent, ratio, and rate;
- 7n11** Represent, compare, and order decimals to hundredths and fractions, using a variety of tools (e.g., number lines, Cuisenaire rods, base ten materials, calculators);
- 7n12** Generate multiples and factors, using a variety of tools and strategies (e.g., identify multiples on a hundreds chart; create rectangles on a geoboard) (Sample problem: List all the rectangles that have an area of  $36 \text{ cm}^2$  and have whole-number dimensions.);
- 7n13** Identify and compare integers found in real-life contexts (e.g.,  $-10^\circ\text{C}$  is much colder than  $+5^\circ\text{C}$ );
- 7n14** Represent and order integers, using a variety of tools (e.g., two-colour counters, virtual manipulatives, number lines);
- 7n15** Select and justify the most appropriate representation of a quantity (i.e., fraction, decimal, percent) for a given context (e.g., "I would use a decimal for recording the length or mass of an object, and a fraction for part of an hour.");
- 7n16** Represent perfect squares and square roots, using a variety of tools (e.g., geoboards, connecting cubes, grid paper);
- 7n17** Explain the relationship between exponential notation and the measurement of area and volume (Sample problem: Explain why area is expressed in square units [units<sup>2</sup>] and volume is expressed in cubic units [units<sup>3</sup>].);
- 7n18** Divide whole numbers by simple fractions and by decimal numbers to hundredths, using concrete materials (e.g., divide 3 by  $\frac{1}{2}$  using fraction strips; divide 4 by 0.8 using base ten materials and estimation);

- 7m19** Use a variety of mental strategies to solve problems involving the addition and subtraction of fractions and decimals (e.g., use the commutative property:  $3 \times \frac{2}{5} \times \frac{1}{3} = 3 \times \frac{1}{3} \times \frac{2}{5}$ , which gives  $1 \times \frac{2}{5} = \frac{2}{5}$ ; use the distributive property:  $16.8 \div 0.2$  can be thought of as  $(16 + 0.8) \div 0.2 = 16 \div 0.2 + 0.8 \div 0.2$ , which gives  $80 + 4 = 84$ );
- 7m20** Solve problems involving the multiplication and division of decimal numbers to thousandths by one-digit whole numbers, using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies (e.g., estimation, algorithms);
- 7m21** Solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies (e.g., estimation, algorithms);
- 7m22** Use estimation when solving problems involving operations with whole numbers, decimals, and percents, to help judge the reasonableness of a solution (Sample problem: A book costs \$18.49. The salesperson tells you that the total price, including taxes, is \$22.37. How can you tell if the total price is reasonable without using a calculator?);
- 7m23** Evaluate expressions that involve whole numbers and decimals, including expressions that contain brackets, using order of operations;
- 7m24** Add and subtract fractions with simple like and unlike denominators, using a variety of tools (e.g., fraction circles, Cuisenaire rods, drawings, calculators) and algorithms;
- 7m25** Demonstrate, using concrete materials, the relationship between the repeated addition of fractions and the multiplication of that fraction by a whole number (e.g.,  $\frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 3 \times \frac{1}{2}$ );
- 7m26** Add and subtract integers, using a variety of tools (e.g., two-colour counters, virtual manipulatives, number lines);
- 7m27** Determine, through investigation, the relationships among fractions, decimals, percents, and ratios;
- 7m28** Solve problems that involve determining whole number percents, using a variety of tools (e.g., base ten materials, paper and pencil, calculators) (Sample problem: If there are 5 blue marbles in a bag of 20 marbles, what percent of the marbles are not blue?);
- 7m29** Demonstrate an understanding of rate as a comparison, or ratio, of two measurements with different units (e.g., speed is a rate that compares distance to time and that can be expressed as kilometres per hour);
- 7m30** Solve problems involving the calculation of unit rates (Sample problem: You go shopping and notice that 25 kg of Ryan's Famous Potatoes cost \$12.95, and 10 kg of Gillian's Potatoes cost \$5.78. Which is the better deal? Justify your answer.).

## Measurement

- 7m31** Report on research into real-life applications of area measurements;
- 7m32** Determine the relationships among units and measurable attributes, including the area of a trapezoid and the volume of a right prism.
- 7m33** Research and report on real-life applications of area measurements (e.g., building a skateboard; painting a room);
- 7m34** Sketch different polygonal prisms that share the same volume (Sample problem: The Neuman Company is designing a new container for its marbles. The container must have a volume of 200 cm<sup>3</sup>. Sketch three possible containers, and explain which one you would recommend.);
- 7m35** Solve problems that require conversion between metric units of measure (e.g., millimetres and centimetres, grams and kilograms, millilitres and litres) (Sample problem: At Andrew's Deli, cheese is on sale for \$11.50 for one kilogram. How much would it cost to purchase 150 g of cheese?);
- 7m36** Solve problems that require conversion between metric units of area (i.e., square centimetres, square metres) (Sample problem: What is the ratio of the number of square metres to the number of square centimetres for a given area? Use this ratio to convert 6.25 m<sup>2</sup> to square centimetres.);
- 7m37** Determine, through investigation using a variety of tools (e.g., concrete materials, dynamic geometry software) and strategies, the relationship for calculating the area of a trapezoid, and generalize to develop the formula [i.e., Area = (sum of lengths of parallel sides  $\times$  height)  $\div$  2] (Sample problem: Determine the relationship between the area of a parallelogram and the area of a trapezoid by composing a parallelogram from congruent trapezoids.);
- 7m38** Solve problems involving the estimation and calculation of the area of a trapezoid;
- 7m39** Estimate and calculate the area of composite two-dimensional shapes by decomposing into shapes with known area relationships (e.g., rectangle, parallelogram, triangle) (Sample problem: Decompose a pentagon into shapes with known area relationships to find the area of the pentagon.);
- 7m40** Determine, through investigation using a variety of tools and strategies (e.g., decomposing right prisms; stacking congruent layers of concrete materials to form a right prism), the relationship between the height, the area of the base, and the volume of right prisms with simple polygonal bases (e.g., parallelograms, trapezoids), and generalize to develop the formula (i.e., Volume = area of base  $\times$  height) (Sample problem: Decompose right prisms with simple polygonal bases into triangular prisms and rectangular prisms. For each prism, record the area of the base, the height, and the volume on a chart. Identify relationships.);
- 7m41** Determine, through investigation using a variety of tools (e.g., nets, concrete materials, dynamic geometry software, Polydrons), the surface area of right prisms;
- 7m42** Solve problems that involve the surface area and volume of right prisms and that require conversion between metric measures of capacity and volume (i.e., millilitres and cubic centimetres) (Sample problem: An aquarium has a base in the shape of a trapezoid. The aquarium is 75 cm high. The base is 50 cm long at the front, 75 cm long at the back, and 25 cm wide. Find the capacity of the aquarium.).

## Geometry and Spatial Sense

- 7m43** Construct related lines, and classify triangles, quadrilaterals, and prisms;
- 7m44** Develop an understanding of similarity, and distinguish similarity and congruence;
- 7m45** Describe location in the four quadrants of a coordinate system, dilate two-dimensional shapes, and apply transformations to create and analyse designs.
- 7m46** Construct related lines (i.e., parallel; perpendicular; intersecting at 30°, 45°, and 60°), using angle properties and a variety of tools (e.g., compass and straight edge, protractor, dynamic geometry software) and strategies (e.g., paper folding);
- 7m47** Sort and classify triangles and quadrilaterals by geometric properties related to symmetry, angles, and sides, through investigation using a variety of tools (e.g., geoboard, dynamic geometry software) and strategies (e.g., using charts, using Venn diagrams) (Sample problem: Investigate whether dilations change the geometric properties of triangles and quadrilaterals.);
- 7m48** Construct angle bisectors and perpendicular bisectors, using a variety of tools (e.g., Mira, dynamic geometry software, compass) and strategies (e.g., paper folding), and represent equal angles and equal lengths using mathematical notation;
- 7m49** Investigate, using concrete materials, the angles between the faces of a prism, and identify right prisms (Sample problem: Identify the perpendicular faces in a set of right prisms.);
- 7m50** Identify, through investigation, the minimum side and angle information (i.e., side-side-side; side-angle-side; angle-side-angle) needed to describe a unique triangle (e.g., "I can draw many triangles if I'm only told the length of one side, but there's only one triangle I can draw if you tell me the lengths of all three sides.");
- 7m51** Determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials, geoboard), relationships among area, perimeter, corresponding side lengths, and corresponding angles of congruent shapes (Sample problem: Do you agree with the conjecture that triangles with the same area must be congruent? Justify your reasoning.);
- 7m52** Demonstrate an understanding that enlarging or reducing two-dimensional shapes creates similar shapes;
- 7m53** Distinguish between and compare similar shapes and congruent shapes, using a variety of tools (e.g., pattern blocks, grid paper, dynamic geometry software) and strategies (e.g., by showing that dilations create similar shapes and that translations, rotations, and reflections generate

congruent shapes) (Sample problem: A larger square can be composed from four congruent square pattern blocks. Identify another pattern block you can use to compose a larger shape that is similar to the shape of the block.).

**7m54** Plot points using all four quadrants of the Cartesian coordinate plane;

**7m55** Identify, perform, and describe dilatations (i.e., enlargements and reductions), through investigation using a variety of tools (e.g., dynamic geometry software, geoboard, pattern blocks, grid paper);

**7m56** Create and analyse designs involving translations, reflections, dilatations, and/or simple rotations of two-dimensional shapes, using a variety of tools (e.g., concrete materials, Mira, drawings, dynamic geometry software) and strategies (e.g., paper folding) (Sample problem: Identify transformations that may be observed in architecture or in artwork [e.g., in the art of M.C. Escher].);

**7m57** Determine, through investigation using a variety of tools (e.g., pattern blocks, Polydrons, grid paper, tiling software, dynamic geometry software, concrete materials), polygons or combinations of polygons that tile a plane, and describe the transformation(s) involved.

### **Patterning and Algebra**

**7m58** Represent linear growing patterns (where the terms are whole numbers) using concrete materials, graphs, and algebraic expressions;

**7m59** Model real-life linear relationships graphically and algebraically, and solve simple algebraic equations using a variety of strategies, including inspection and guess and check;

**7m60** Represent linear growing patterns, using a variety of tools (e.g., concrete materials, paper and pencil, calculators, spreadsheets) and strategies (e.g., make a table of values using the term number and the term; plot the coordinates on a graph; write a pattern rule using words);

**7m61** Make predictions about linear growing patterns, through investigation with concrete materials (Sample problem: Investigate the surface area of towers made from a single column of connecting cubes, and predict the surface area of a tower that is 50 cubes high. Explain your reasoning.);

**7m62** Develop and represent the general term of a linear growing pattern, using algebraic expressions involving one operation (e.g., the general term for the sequence 4, 5, 6, 7, ... can be written algebraically as  $n + 3$ , where  $n$  represents the term number; the general term for the sequence 5, 10, 15, 20, ... can be written algebraically as  $5n$ , where  $n$  represents the term number);

**7m63** Compare pattern rules that generate a pattern by adding or subtracting a constant, or multiplying or dividing by a constant, to get the next term (e.g., for 1, 3, 5, 7, 9, ..., the pattern rule is "start at 1 and add 2 to each term to get the next term") with pattern rules that use the term number to describe the general term (e.g., for 1, 3, 5, 7, 9, ..., the pattern rule is "double the term number and subtract 1", which can be written algebraically as  $2 \times n - 1$ ) (Sample problem: For the pattern 1, 3, 5, 7, 9, ..., investigate and compare different ways of finding the 50th term.);

**7m64** Model real-life relationships involving constant rates where the initial condition starts at 0 (e.g., speed, heart rate, billing rate), through investigation using tables of values and graphs (Sample problem: Create a table of values and graph the relationship between distance and time for a car travelling at a constant speed of 40 km/h. At that speed, how far would the car travel in 3.5 h? How many hours would it take to travel 220 km?);

**7m65** Model real-life relationships involving constant rates (e.g., speed, heart rate, billing rate), using algebraic equations with variables to represent the changing quantities in the relationship (e.g., the equation  $p = 4t$  represents the relationship between the total number of people that can be seated ( $p$ ) and the number of tables ( $t$ ), given that each table can seat 4 people [4 people per table is the constant rate]);

**7m66** Translate phrases describing simple mathematical relationships into algebraic expressions (e.g., one more than three times a number can be written algebraically as  $1 + 3x$  or  $3x + 1$ ), using concrete materials (e.g., algebra tiles, pattern blocks, counters);

**7m67** Evaluate algebraic expressions by substituting natural numbers for the variables;

**7m68** Make connections between evaluating algebraic expressions and determining the term in a pattern using the general term (e.g., for 3, 5, 7, 9, ..., the general term is the algebraic expression  $2n + 1$ ; evaluating this expression when  $n = 12$  tells you that the 12th term is  $2(12) + 1$ , which equals 25);

**7m69** Solve linear equations of the form  $ax = c$  or  $c = ax$  and  $ax + b = c$  or variations such as  $b + ax = c$  and  $c = bx + a$  (where  $a$ ,  $b$ , and  $c$  are natural numbers) by modelling with concrete materials, by inspection, or by guess and check, with and without the aid of a calculator (e.g., "I solved  $x + 7 = 15$  by using guess and check. First I tried 6 for  $x$ . Since I knew that 6 plus 7 equals 13 and 13, is less than 15, then I knew that  $x$  must be greater than 6.").

### **Data Management and Probability**

**7m70** Collect and organize categorical, discrete, or continuous primary data and secondary data and display the data using charts and graphs, including relative frequency tables and circle graphs;

**7m71** Make and evaluate convincing arguments, based on the analysis of data;

**7m72** Compare experimental probabilities with the theoretical probability of an outcome involving two independent events;

**7m73** Collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject and record observations or measurements;

**7m74** Collect and organize categorical, discrete, or continuous primary data and secondary data (e.g., electronic data from websites such as E-Stat or Census At Schools) and display the data in charts, tables, and graphs (including relative frequency tables and circle graphs) that have appropriate titles, labels (e.g., appropriate units marked on the axes), and scales (e.g., with appropriate increments) that suit the range and distribution of the data, using a variety of tools (e.g., graph paper, spreadsheets, dynamic statistical software);

**7m75** Select an appropriate type of graph to represent a set of data, graph the data using technology, and justify the choice of graph (i.e., from types of graphs already studied);

**7m76** Distinguish between a census and a sample from a population;

**7m77** Identify bias in data collection methods (Sample problem: How reliable are your results if you only sample girls to determine the favourite type of book read by students in your grade?);

**7m78** Read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., temperature data or community data in the newspaper, data from the Internet about populations) presented in charts, tables, and graphs (including relative frequency tables and circle graphs);

**7m79** Identify, through investigation, graphs that present data in misleading ways (e.g., line graphs that exaggerate change by starting the vertical axis at a point greater than zero);

**7m80** Determine, through investigation, the effect on a measure of central tendency (i.e., mean, median, and mode) of adding or removing a value or values (e.g., changing the value of an outlier may have a significant effect on the mean but no effect on the median) (Sample problem: Use a set of data whose distribution across its range looks symmetrical, and change some of the values so that the distribution no longer looks symmetrical. Does the change affect the median more than the mean? Explain your thinking.);

**7m81** Identify and describe trends, based on the distribution of the data presented in tables and graphs, using informal language;

**7m82** Make inferences and convincing arguments that are based on the analysis of charts, tables, and graphs (Sample problem: Use census information to predict whether Canada's population is likely to increase.);

**7m83** Research and report on real-world applications of probabilities expressed in fraction, decimal, and percent form (e.g., lotteries, batting averages, weather forecasts, elections);

- 7m84** Make predictions about a population when given a probability (Sample problem: The probability that a fish caught in Lake Goodfish is a bass is 29%. Predict how many bass will be caught in a fishing derby there, if 500 fish are caught.);
- 7m85** Represent in a variety of ways (e.g., tree diagrams, tables, models, systematic lists) all the possible outcomes of a probability experiment involving two independent events (i.e., one event does not affect the other event), and determine the theoretical probability of a specific outcome involving two independent events (Sample problem: What is the probability of rolling a 4 and spinning red, when you roll a number cube and spin a spinner that is equally divided into four different colours?);
- 7m86** Perform a simple probability experiment involving two independent events, and compare the experimental probability with the theoretical probability of a specific outcome (Sample problem: Place 1 red counter and 1 blue counter in an opaque bag. Draw a counter, replace it, shake the bag, and draw again. Compare the theoretical and experimental probabilities of drawing a red counter 2 times in a row.).

## Mathematics (Grade 8 Expectations, 2005)

### Mathematical Process Expectations

- 8m1** Develop, select, apply, and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
- 8m2** Develop and apply reasoning skills (e.g., recognition of relationships, generalization through inductive reasoning, use of counter-examples) to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments;
- 8m3** Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by assessing the effectiveness of strategies and processes used, by proposing alternative approaches, by judging the reasonableness of results, by verifying solutions);
- 8m4** Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;
- 8m5** Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, current events, art and culture, sports);
- 8m6** Create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;
- 8m7** Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

### Number Sense and Numeration

- 8m8** *Represent, compare, and order equivalent representations of numbers, including those involving positive exponents;*
- 8m9** *Solve problems involving whole numbers, decimal numbers, fractions, and integers, using a variety of computational strategies;*
- 8m10** *Solve problems by using proportional reasoning in a variety of meaningful contexts;*
- 8m11** Express repeated multiplication using exponential notation (e.g.,  $2 \times 2 \times 2 \times 2 = 2^4$ );
- 8m12** Represent whole numbers in expanded form using powers of ten (e.g.,  $347 = 3 \times 10^2 + 4 \times 10^1 + 7$ );
- 8m13** Represent, compare, and order rational numbers (i.e., positive and negative fractions and decimals to thousandths);
- 8m14** Translate between equivalent forms of a number (i.e., decimals, fractions, percents) (e.g.,  $3/4 = 0.75$ );
- 8m15** Determine common factors and common multiples using the prime factorization of numbers (e.g., the prime factorization of 12 is  $2 \times 2 \times 3$ ; the prime factorization of 18 is  $2 \times 3 \times 3$ ; the greatest common factor of 12 and 18 is  $2 \times 3$  or 6; the least common multiple of 12 and 18 is  $2 \times 2 \times 3 \times 3$  or 36).
- 8m16** Solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools (e.g., graphs, calculators) and strategies (e.g., estimation, algorithms);
- 8m17** Solve problems involving percents expressed to one decimal place (e.g., 12.5%) and whole-number percents greater than 100 (e.g., 115%) (Sample problem: The total cost of an item with tax included [115%] is \$23.00. Use base ten materials to determine the price before tax.);
- 8m18** Use estimation when solving problems involving operations with whole numbers, decimals, percents, integers, and fractions, to help judge the reasonableness of a solution;
- 8m19** Represent the multiplication and division of fractions, using a variety of tools and strategies (e.g., use an area model to represent  $1/4$  multiplied by  $1/3$ );
- 8m20** Solve problems involving addition, subtraction, multiplication, and division with simple fractions;
- 8m21** Represent the multiplication and division of integers, using a variety of tools [e.g., if black counters represent positive amounts and red counters represent negative amounts, you can model  $3 \times (-2)$  as three groups of two red counters];
- 8m22** Solve problems involving operations with integers, using a variety of tools (e.g., two-colour counters, virtual manipulatives, number lines);
- 8m23** Evaluate expressions that involve integers, including expressions that contain brackets and exponents, using order of operations;
- 8m24** Multiply and divide decimal numbers by various powers of ten (e.g., "To convert 230 000  $\text{cm}^3$  to cubic metres, I calculated in my head  $230000 \div 10^6$  to get 0.23  $\text{m}^3$ .") (Sample problem: Use a calculator to help you generalize a rule for dividing numbers by 1 000 000.);
- 8m25** Estimate, and verify using a calculator, the positive square roots of whole numbers, and distinguish between whole numbers that have whole-number square roots (i.e., perfect square numbers) and those that do not (Sample problem: Explain why a square with an area of 20  $\text{cm}^2$  does not have a whole-number side length.);
- 8m26** Identify and describe real-life situations involving two quantities that are directly proportional (e.g., the number of servings and the quantities in a recipe, mass and volume of a substance, circumference and diameter of a circle);
- 8m27** Solve problems involving proportions, using concrete materials, drawings, and variables (Sample problem: The ratio of stone to sand in HardFast Concrete is 2 to 3. How much stone is needed if 15 bags of sand are used?);
- 8m28** Solve problems involving percent that arise from real-life contexts (e.g., discount, sales tax, simple interest) (Sample problem: In Ontario, people often pay a provincial sales tax [PST] of 8% and a federal sales tax [GST] of 7% when they make a purchase. Does it matter which tax is calculated first? Explain your reasoning.);
- 8m29** Solve problems involving rates (Sample problem: A pack of 24 CDs costs \$7.99. A pack of 50 CDs costs \$10.45. What is the most economical way to purchase 130 CDs?).

### Measurement

- 8m30** *Research, describe, and report on applications of volume and capacity measurement;*
- 8m31** *Determine the relationships among units and measurable attributes, including the area of a circle and the volume of a cylinder;*
- 8m32** Research, describe, and report on applications of volume and capacity measurement (e.g., cooking, closet space, aquarium size) (Sample problem: Describe situations where volume and capacity are used in your home.);

- 8m33** Solve problems that require conversions involving metric units of area, volume, and capacity (i.e., square centimeters and square metres; cubic centimetres and cubic metres; millilitres and cubic centimetres) (Sample problem: What is the capacity of a cylindrical beaker with a radius of 5 cm and a height of 15 cm?);
- 8m34** Measure the circumference, radius, and diameter of circular objects, using concrete materials (Sample Problem: Use string to measure the circumferences of different circular objects.);
- 8m35** Determine, through investigation using a variety of tools (e.g., cans and string, dynamic geometry software) and strategies, the relationships for calculating the circumference and the area of a circle, and generalize to develop the formulas [i.e., Circumference of a circle =  $\pi \times$  diameter; Area of a circle =  $\pi \times$  (radius)<sup>2</sup>] (Sample problem: Use string to measure the circumferences and the diameters of a variety of cylindrical cans, and investigate the ratio of the circumference to the diameter.);
- 8m36** Solve problems involving the estimation and calculation of the circumference and the area of a circle;
- 8m37** Determine, through investigation using a variety of tools and strategies (e.g., generalizing from the volume relationship for right prisms, and verifying using the capacity of thin-walled cylindrical containers), the relationship between the area of the base and height and the volume of a cylinder, and generalize to develop the formula (i.e., Volume = area of base  $\times$  height);
- 8m38** Determine, through investigation using concrete materials, the surface area of a cylinder (Sample problem: Use the label and the plastic lid from a cylindrical container to help determine its surface area.);
- 8m39** Solve problems involving the surface area and the volume of cylinders, using a variety of strategies (Sample problem: Compare the volumes of the two cylinders that can be created by taping the top and bottom, or the other two sides, of a standard sheet of paper.).

### Geometry and Spatial Sense

- 8m40** *Demonstrate an understanding of the geometric properties of quadrilaterals and circles and the applications of geometric properties in the real world;*
- 8m41** *Develop geometric relationships involving lines, triangles, and polyhedra, and solve problems involving lines and triangles;*
- 8m42** *Represent transformations using the Cartesian coordinate plane, and make connections between transformations and the real world.*
- 8m43** Sort and classify quadrilaterals by geometric properties, including those based on diagonals, through investigation using a variety of tools (e.g., concrete materials, dynamic geometry software) (Sample problem: Which quadrilaterals have diagonals that bisect each other perpendicularly?);
- 8m44** Construct a circle, given its centre and radius, or its centre and a point on the circle, or three points on the circle;
- 8m45** Investigate and describe applications of geometric properties (e.g., properties of triangles, quadrilaterals, and circles) in the real world.
- 8m46** Determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials, geoboard), relationships among area, perimeter, corresponding side lengths, and corresponding angles of similar shapes (Sample problem: Construct three similar rectangles, using grid paper or a geoboard, and compare the perimeters and areas of the rectangles.);
- 8m47** Determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials, protractor) and strategies (e.g., paper folding), the angle relationships for intersecting lines and for parallel lines and transversals, and the sum of the angles of a triangle;
- 8m48** Solve angle-relationship problems involving triangles (e.g., finding interior angles or complementary angles), intersecting lines (e.g., finding supplementary angles or opposite angles), and parallel lines and transversals (e.g., finding alternate angles or corresponding angles);
- 8m49** Determine the Pythagorean relationship, through investigation using a variety of tools (e.g., dynamic geometry software; paper and scissors; geoboard) and strategies;
- 8m50** Solve problems involving right triangles geometrically, using the Pythagorean relationship;
- 8m51** Determine, through investigation using concrete materials, the relationship between the numbers of faces, edges, and vertices of a polyhedron (i.e., number of faces + number of vertices = number of edges + 2) (Sample problem: Use Polydrons and/or paper nets to construct the five Platonic solids [i.e., tetrahedron, cube, octahedron, dodecahedron, icosahedron], and compare the sum of the numbers of faces and vertices to the number of edges for each solid.);
- 8m52** Graph the image of a point, or set of points, on the Cartesian coordinate plane after applying a transformation to the original point(s) (i.e., translation; reflection in the x-axis, the y-axis, or the angle bisector of the axes that passes through the first and third quadrants; rotation of 90°, 180°, or 270° about the origin);
- 8m53** Identify, through investigation, real-world movements that are translations, reflections, and rotations.

### Patterning and Algebra

- 8m54** *Represent linear growing patterns (where the terms are whole numbers) using graphs, algebraic expressions, and equations;*
- 8m55** *Model linear relationships graphically and algebraically, and solve and verify algebraic equations, using a variety of strategies, including inspection, guess and check, and using a "balance" model.*
- 8m56** Represent, through investigation with concrete materials, the general term of a linear pattern, using one or more algebraic expressions (e.g., "Using toothpicks, I noticed that 1 square needs 4 toothpicks, 2 connected squares need 7 toothpicks, and 3 connected squares need 10 toothpicks. I think that for  $n$  connected squares I will need  $4 + 3(n - 1)$  toothpicks, because the number of toothpicks keeps going up by 3 and I started with 4 toothpicks. Or, if I think of starting with 1 toothpick and adding 3 toothpicks at a time, the pattern can be represented as  $1 + 3n$ .");
- 8m57** Represent linear patterns graphically (i.e., make a table of values that shows the term number and the term, and plot the coordinates on a graph), using a variety of tools (e.g., graph paper, calculators, dynamic statistical software);
- 8m58** Determine a term, given its term number, in a linear pattern that is represented by a graph or an algebraic equation (Sample problem: Given the graph that represents the pattern 1, 3, 5, 7, ..., find the 10th term. Given the algebraic equation that represents the pattern,  $t = 2n - 1$ , find the 100th term.);
- 8m59** Describe different ways in which algebra can be used in real-life situations (e.g., the value of \$5 bills and toonies placed in an envelope for fund raising can be represented by the equation  $v = 5f + 2t$ );
- 8m60** Model linear relationships using tables of values, graphs, and equations (e.g., the sequence 2, 3, 4, 5, 6, ... can be represented by the equation  $t = n + 1$ , where  $n$  represents the term number and  $t$  represents the term), through investigation using a variety of tools (e.g., algebra tiles, pattern blocks, connecting cubes, base ten materials) (Sample problem: Leah put \$350 in a bank certificate that pays 4% simple interest each year. Make a table of values to show how much the bank certificate is worth after five years, using base ten materials to help you. Represent the relationship using an equation.);
- 8m61** Translate statements describing mathematical relationships into algebraic expressions and equations (e.g., for a collection of triangles, the total number of sides is equal to three times the number of triangles or  $s = 3n$ );
- 8m62** Evaluate algebraic expressions with up to three terms, by substituting fractions, decimals, and integers for the variables (e.g., evaluate  $3x + 4y = 2z$ , where  $x = 1/2$ ,  $y = 0.6$ , and  $z = -1$ );
- 8m63** Make connections between solving equations and determining the term number in a pattern, using the general term (e.g., for the pattern with the general term  $2n + 1$ , solving the equation  $2n + 1 = 17$  tells you the term number when the term is 17);
- 8m64** Solve and verify linear equations involving a one-variable term and having solutions that are integers, by using inspection, guess and check, and a "balance" model (Sample problem: What is the value of the variable in the equation  $30x - 5 = 10$ ?).

## **Data Management and Probability**

- 8m65** Collect and organize categorical, discrete, or continuous primary data and secondary data and display the data using charts and graphs, including frequency tables with intervals, histograms, and scatter plots;
- 8m66** Apply a variety of data management tools and strategies to make convincing arguments about data;
- 8m67** Use probability models to make predictions about real-life events;
- 8m68** Collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject, and record observations or measurements;
- 8m69** Organize into intervals a set of data that is spread over a broad range (e.g., the age of respondents to a survey may range over 80 years and may be organized into ten-year intervals);
- 8m70** Collect and organize categorical, discrete, or continuous primary data and secondary data (e.g., electronic data from websites such as E-Stat or Census At Schools), and display the data in charts, tables, and graphs (including histograms and scatter plots) that have appropriate titles, labels (e.g., appropriate units marked on the axes), and scales (e.g., with appropriate increments) that suit the range and distribution of the data, using a variety of tools (e.g., graph paper, spreadsheets, dynamic statistical software);
- 8m71** Select an appropriate type of graph to represent a set of data, graph the data using technology, and justify the choice of graph (i.e., from types of graphs already studied, including histograms and scatter plots); – explain the relationship between a census, a representative sample, sample size, and a population (e.g., "I think that in most cases a larger sample size will be more representative of the entire population.");
- 8m72** Explain the relationship between a census, a representative sample, sample size, and a population (e.g., "I think that in most cases a larger sample size will be more representative of the entire population.");
- 8m73** Read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., election data or temperature data from the newspaper, data from the Internet about lifestyles), presented in charts, tables, and graphs (including frequency tables with intervals, histograms, and scatter plots);
- 8m74** Determine, through investigation, the appropriate measure of central tendency (i.e., mean, median, or mode) needed to compare sets of data (e.g., in hockey, compare heights or masses of players on defence with that of forwards);
- 8m75** Demonstrate an understanding of the appropriate uses of bar graphs and histograms by comparing their characteristics (Sample problem: How is a histogram similar to and different from a bar graph? Use examples to support your answer.);
- 8m76** Compare two attributes or characteristics (e.g., height versus arm span), using a scatter plot, and determine whether or not the scatter plot suggests a relationship (Sample problem: Create a scatter plot to compare the lengths of the bases of several similar triangles with their areas.);
- 8m77** Identify and describe trends, based on the rate of change of data from tables and graphs, using informal language (e.g., "The steep line going upward on this graph represents rapid growth. The steep line going downward on this other graph represents rapid decline.");
- 8m78** Make inferences and convincing arguments that are based on the analysis of charts, tables, and graphs (Sample problem: Use data to make a convincing argument that the environment is becoming increasingly polluted.);
- 8m79** Compare two attributes or characteristics, using a variety of data management tools and strategies (i.e., pose a relevant question, then design an experiment or survey, collect and analyse the data, and draw conclusions) (Sample problem: Compare the length and width of different-sized leaves from a maple tree to determine if maple leaves grow proportionally. What generalizations can you make?);
- 8m80** Compare, through investigation, the theoretical probability of an event (i.e., the ratio of the number of ways a favourable outcome can occur compared to the total number of possible outcomes) with experimental probability, and explain why they might differ (Sample problem: Toss a fair coin 10 times, record the results, and explain why you might not get the predicted result of 5 heads and 5 tails.);
- 8m81** Determine, through investigation, the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases, using class-generated data and technology-based simulation models (Sample problem: Compare the theoretical probability of getting a 6 when tossing a number cube with the experimental probabilities obtained after tossing a number cube once, 10 times, 100 times, and 1000 times.);
- 8m82** Identify the complementary event for a given event, and calculate the theoretical probability that a given event will not occur (Sample problem: Bingo uses the numbers from 1 to 75. If the numbers are pulled at random, what is the probability that the first number is a multiple of 5? is not a multiple of 5?).

**Ontario Curriculum (Revised, 2005) Expectation codes available at the Ontario Curriculum Unit Planner site: [http://www.ocup.org/resources/Ontario\\_Curriculum\\_Mathematics\\_Expectations\\_List\\_with\\_Codes\\_Formatted\\_by\\_Dr.\\_Daniel\\_Jarvis,\\_Nipissing\\_University,\\_2006](http://www.ocup.org/resources/Ontario_Curriculum_Mathematics_Expectations_List_with_Codes_Formatted_by_Dr._Daniel_Jarvis,_Nipissing_University,_2006)**