Mathematics, Grade 4

Expectations by strand

A. Social-Emotional Learning (SEL) Skills in Mathematics and the Mathematical Processes

This strand focuses on students' development and application of social-emotional learning skills to support their learning of math concepts and skills, foster their overall well-being and ability to learn, and help them build resilience and thrive as math learners. As they develop SEL skills, students demonstrate a greater ability to understand and apply the mathematical processes, which are critical to supporting learning in mathematics. In all grades of the mathematics program, the learning related to this strand takes place in the context of learning related to all other strands, and it should be assessed and evaluated within these contexts.

Overall expectations

Throughout this grade, in order to promote a positive identity as a math learner, to foster well-being and the ability to learn, build resilience, and thrive, students will:

A1. Social-Emotional Learning (SEL) Skills and the Mathematical Processes

apply, to the best of their ability, a variety of social-emotional learning skills to support their use of the mathematical processes and their learning in connection with the expectations in the other five strands of the mathematics curriculum

To the best of their ability, students will learn to:	… as they apply the mathematical processes:	… so they can:
1. identify and manage emotions	• ***problem solving:*** develop, select, and apply problem-solving strategies • ***reasoning and proving:*** develop and apply reasoning skills (e.g., classification, recognition of relationships, use of counter-examples) to justify thinking, make and investigate conjectures, and construct and defend arguments • ***reflecting:*** demonstrate that as they solve problems, they are pausing, looking back, and monitoring their thinking to help clarify their understanding (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) • ***connecting:*** make connections among mathematical concepts, procedures, and representations, and relate mathematical ideas to other contexts (e.g., other curriculum areas, daily life, sports) • ***communicating:*** express and understand mathematical thinking, and engage in mathematical arguments using everyday language, language resources as necessary, appropriate mathematical terminology, a variety of representations, and mathematical conventions • ***representing:*** select from and create a variety of representations of mathematical ideas (e.g.,	1. express and manage their feelings, and show understanding of the feelings of others, as they engage positively in mathematics activities
2. recognize sources of stress and cope with challenges		2. work through challenging math problems, understanding that their resourcefulness in using various strategies to respond to stress is helping them build personal resilience
3. maintain positive motivation and perseverance		3. recognize that testing out different approaches to problems and learning from mistakes is an important part of the learning process, and is aided by a sense of optimism and hope
4. build relationships and communicate effectively		4. work collaboratively on math problems – expressing their thinking, listening to the thinking of others, and practising inclusivity – and in that way fostering healthy relationships
5. develop self-awareness and sense of identity		5. see themselves as capable math learners, and strengthen their sense of ownership of their learning, as part of their emerging sense of identity and belonging

6. think critically and creatively	representations involving physical models, pictures, numbers, variables, graphs), and apply them to solve problems • ***selecting tools and strategies:*** select and use a variety of concrete, visual, and electronic learning tools and appropriate strategies to investigate mathematical ideas and to solve problems	6. make connections between math and everyday contexts to help them make informed judgements and decisions

B. Number

Overall expectations

By the end of Grade 4, students will:

B1. Number Sense

demonstrate an understanding of numbers and make connections to the way numbers are used in everyday life

Specific expectations

By the end of Grade 4, students will:

B1.1 Whole Numbers

read, represent, compose, and decompose whole numbers up to and including 10 000, using appropriate tools and strategies, and describe various ways they are used in everyday life

Teacher supports

Key concepts

- Reading numbers involves interpreting them as a quantity when they are expressed in words, in standard notation, or represented using physical objects or diagrams.
- The numerals 0 to 9 are used to form numbers. They are referred to as the digits in a number and each digit corresponds to a place value. For example, in the number 4107, the digit 4 represents 4 thousands, the digit 1 represents 1 hundred, the digit 0 represents 0 tens, and the digit 7 represents 7 ones.

- There are patterns in the way numbers are formed. Each place value column repeats the 0 to 9 counting sequence. Any quantity, no matter how great, can be described in terms of its place value.
- A number can be represented in expanded form (e.g., 4187 = 4000 + 100 + 80 + 7 or 4 × 1000 + 1 × 100 + 8 × 10 + 7 × 1) to show place value relationships.
- Numbers can be composed and decomposed in various ways, including by place value.
- Numbers are composed when two or more numbers are combined to create a larger number. For example, 1300, 200, and 6 combine to make 1506.
- Numbers are decomposed when they are represented as a composition of two or more smaller numbers. For example, 5125 can be decomposed into 5000 and 100 and 25.
- Tools may be used when representing numbers. For example, 1362 may be represented as the sum of 136 ten-dollar bills and 1 toonie or 13 base ten flats, 6 base ten rods, and 2 base ten units.
- Numbers are used throughout the day, in various ways and contexts. Most often, numbers describe and compare quantities. They express magnitude and provide a way to answer questions such as "how much?" and "how much more?".

Note

- Every strand of mathematics relies on numbers.
- When a number is decomposed and then recomposed, the quantity is unchanged. This is the conservation principle.
- There are non-standard but equivalent ways to decompose a number using place value, based on understanding the relationships between the place values. For example, 587 could be decomposed as 58 tens and 7 ones or decomposed as 50 tens and 87 ones, and so on.
- Composing and decomposing numbers in a variety of ways can support students in becoming flexible with their mental math strategies.
- Closed number lines with appropriate scales can be used to represent numbers as a position on a number line or as a distance from zero. Depending on the number, estimation may be needed to represent it on a number line.
- Partial number lines can be used to show the position of a number relative to other numbers.
- Open number lines can be used to show the composition of large numbers without drawing them to scale.
- It is important for students to understand key aspects of place value. For example:

    - The order of the digits makes a difference. The number 385 describes a different quantity than the number 853.
    - The *place* (or position) of a digit determines its *value* (*place value*). The 5 in 511, for example, has a value of 500, not 5. To determine the value of a digit in a number,

multiply the value of the digit by the value of its place. For example, in the number 5236, the 5 represents 5000 (5 × 1000) and the 2 represents 200 (2 × 100).
  - A zero in a column indicates that there are no groups of that size in the number. It serves as a placeholder, holding the other digits in their correct "place". For example, 189 means 1 hundred, 8 tens, and 9 ones, but 1089 means 1 thousand, 0 hundreds, 8 tens, and 9 ones.
  - The value of the digits in each of the positions follows a "times 10" multiplicative pattern. For example, 500 is 10 times greater than 50, 50 is 10 times greater than 5, and 5 is 10 times greater than 0.5.

- Going from left to right, a "hundreds-tens-ones" pattern repeats within each period (ones, thousands, millions, billions, and so on). Exposure to this larger pattern and the names of the periods – into millions and beyond – satisfies a natural curiosity around "big numbers", although students at this grade do not need to work beyond thousands.

Place Value Patterns

one billions	hundred millions	ten millions	one millions	hundred thousands	ten thousands	one thousands	hundreds	tens	ones

B1.2 Whole Numbers

compare and order whole numbers up to and including 10 000, in various contexts

Teacher supports

Key concepts

- Numbers are compared and ordered according to their "how muchness" or magnitude.
- Numbers with the same units can be compared directly (e.g., 7645 kilometres compared to 6250 kilometres). Numbers that do not show a unit are assumed to have units of ones (e.g., 75 and 12 are considered as 75 ones and 12 ones).
- Sometimes numbers without the same unit can be compared, such as 625 kilometres and 75 metres. Knowing that the unit "kilometres" is greater than the unit "metres", and knowing that 625 is greater than 75, one can infer that 625 kilometres is a greater distance than 75 metres.
- Benchmark numbers can be used to compare quantities. For example, 4132 is less than 5000 and 6200 is greater than 5000, so 4132 is less than 6200.
- Numbers can be compared by their place value. For example, when comparing 8250 and 8450, the greatest place value where the numbers differ is compared. For this example, 2

hundreds (from 8250) and 4 hundreds (from 8450) are compared. Since 4 hundreds is greater than 2 hundreds, 8450 is greater than 8250.
- Numbers can be ordered in ascending order – from least to greatest – or can be ordered in descending order – from greatest to least.

Note

- An understanding of place value enables whole numbers to be compared and ordered. There is a stable order to how numbers are sequenced, and patterns exist within this sequence that make it possible to predict the order of numbers and make comparisons.

B1.3 Whole Numbers

round whole numbers to the nearest ten, hundred, or thousand, in various contexts

Teacher supports

Key concepts

- Rounding numbers is often done to estimate a quantity or measure, estimate the results of a computation, and make quick comparisons.
- Rounding involves making decisions about what level of precision is needed, and is used often in measurement. How close a rounded number is to the actual amount depends on the unit it is being rounded to. The result of rounding a number to the nearest ten is closer to the original number than the result of rounding the same number to the nearest hundred. Similarly, the result of rounding a number rounded to the nearest hundred is closer to the original number than the result of rounding the same number to the nearest thousand. The larger the unit, the broader the approximation; the smaller the unit, the more precise.
- Whether a number is rounded up or down depends on the context. For example, when paying by cash in a store, the amount owing is rounded to the nearest five cents (or nickel).
- In the absence of a context, numbers are typically rounded on a midpoint. This approach visualizes the amount that is halfway between two units and determines whether a number is closer to one unit than the other.

    - Rounding 1237 to the nearest 10 becomes 1240, since 1237 is closer to 1240 than 1230.
    - Rounding 1237 to the nearest 100 becomes 1200, since 1237 is closer to 1200 than 1300.

- Rounding 1237 to the nearest 1000 becomes 1000, since 1237 is closer to 1000 than 2000.
- If a number is exactly on the midpoint, convention rounds the number up (unless the context suggests differently). So, 1235 rounded to the nearest 10 becomes 1240.

B1.4 Fractions and Decimals

represent fractions from halves to tenths using drawings, tools, and standard fractional notation, and explain the meanings of the denominator and the numerator

Teacher supports

Key concepts

- A fraction is a number that tells us about the relationship between two quantities.
- A fraction can represent a quotient (division).
  - It shows the relationship between the number of wholes (numerator) and the number of partitions the whole is being divided into (denominator).
  - For example, 3 granola bars (3 wholes) are shared equally with 4 people (number of partitions), which can be expressed as $\frac{3}{4}$.
- A fraction can represent a part of a whole.
  - It shows the relationship between the number of parts selected (numerator) and the total number of parts in one whole (denominator).
  - For example, if 1 granola bar (1 whole) is partitioned into 4 pieces (partitions), each piece is one fourth ($\frac{1}{4}$) of the granola bar. Two pieces are 2 one fourths ($\frac{2}{4}$) of the granola bar, three pieces are three one fourths ($\frac{3}{4}$) of the granola bar, and four pieces are four one fourths ($\frac{4}{4}$) of the granola bar.
- A fraction can represent a comparison.
  - It shows the relationship between two parts of the same whole. The numerator is one part and the denominator is the other part.
  - For example, a bag has 3 red beads and 2 yellow beads. The fraction $\frac{2}{3}$ represents that there are two thirds as many yellow beads as red beads. The fraction $\frac{3}{2}$, which

is $1\frac{1}{2}$ as a mixed number, represents that there are 1 and one half times more red beads than yellow beads.

- A fraction can represent an operator.
  - When considering fractions as an operator, the fraction increases or decrease by a factor.
  - For example, in the case of $\frac{3}{4}$ of a granola bar, $\frac{3}{4}$of \$100, or $\frac{3}{4}$of a rectangle, the fraction reduces the original quantity to $\frac{3}{4}$ its original size.

Note

- A fraction is a number that can tell us information about the relationship between two quantities. These two quantities are expressed as parts and wholes in different ways, depending on the way the fraction is used.
  - $\frac{3}{4}$ as a quotient (3 ÷ 4): 3 represents three wholes divided into 4 equal parts (wholes to parts relationship).
  - $\frac{3}{4}$ as a part of a whole: 3 is representing the number of parts selected from a whole that has been partitioned into 4 equal parts (parts to a whole relationship).
  - $\frac{3}{4}$ as a comparison: 3 parts of a whole compared to 4 parts of the same whole (parts to parts of the same whole relationship).
- A fraction is an operator when one interprets a fraction relative to a whole. For example, each person gets three fourths of a granola bar, or three one fourths of the area is shaded.

B1.5 Fractions and Decimals

use drawings and models to represent, compare, and order fractions representing the individual portions that result from two different fair-share scenarios involving any combination of 2, 3, 4, 5, 6, 8, and 10 sharers

Teacher supports

Key concepts

- Fair sharing means that quantities are shared equally. For a whole to be shared equally, it must be partitioned in such a way that each sharer receives the same amount.

- Fair-share or equal-share problems can be represented using various models. The choice of model may be influenced by the context of the problem. For example,
  - A set model may be chosen when the problem is dealing with objects such as beads or sticker books. The whole may be the entire set or each item in the set.
  - A linear model may be chosen when the problem is dealing with things involving length, like the length of a ribbon or the distance between two points.
  - An area model may be chosen when the problem is dealing with two-dimensional shapes like a garden plot or a flag.
- Fractions that are based on the same whole can be compared by representing them using various tools and models. For example, if an area model is chosen, then the area that the fractions represent are compared. If a linear model is chosen, then the lengths that the fractions represent are compared.
- Ordering fractions requires an analysis of the fractional representations. For example, when using an area model, the greater fraction covers the most area. If using a linear model, the fraction with the larger length is the greater fraction.

Note

- Words can have multiple meanings. It is important to be aware that in many situations, fair does not mean equal, and equal is not equitable. Educators should clarify how they are using the term "fair share" and ensure that students understand that in the math context fair means equal and the intent behind such math problems is to find equal amounts.
- Fair-share or equal-share problems provide a natural context for students to encounter fractions and division. Present these problems in the way that students will best connect to.
- Different modes and tools can be used to represent fractions:
  - Set models include collections of objects (e.g., beads in a bag, stickers in a sticker book), where each object is considered an equal part of the set. The attributes of the set (e.g., colour, size, shape) may or not be considered. Either each item in the set can be considered one whole or the entire set can be considered as the whole, depending on the context of the problem. If the entire set is the whole it will be important that the tool used can be easily partitioned. For example, concrete pattern blocks are difficult to partition; however, paper pattern blocks could be cut.
  - Linear models include number lines, the length of relational rods, and line segments. It is important for students to know the difference between $\frac{3}{4}$ of a line segment and $\frac{3}{4}$ as a position on a number line. Three fourths of a line segment treats the fraction as an operator and the whole is represented by the entire length

of the line segment; for example, if the whole line segment represents 8 apples, then $\frac{3}{4}$ would be positioned at the 6. Three fourths as a position on a number line treats the fraction as a part-whole relationship where the number 1 on the number line is 1 whole, the number 2 on the number line is 2 wholes, and so on. So as a position, $\frac{3}{4}$ is located three fourths of the way from 0 to 1.

- Other measurement models include area, volume, capacity, and mass. Area is the most common model used with shapes like rectangles and circles. Circles are difficult to partition when the fractions are not halves, fourths, or eighths, so providing models of partitioned circles is imperative. Making connections to the analog clock may also be helpful; for example, $\frac{1}{4}$ past the hour.

B1.6 Fractions and Decimals

count to 10 by halves, thirds, fourths, fifths, sixths, eighths, and tenths, with and without the use of tools

Teacher supports

Key concepts

- To count by a fractional amount is to count by a unit fraction. For example, when counting by the unit fraction one third, the sequence is: 1 one third, 2 one thirds, 3 one thirds, and so on. Counting by unit fractions can reinforce that the numerator is actually counting units. A fractional count equivalent to the unit fraction makes one whole (e.g., 3 one thirds).
- A fractional count can exceed one whole. For example, 5 one thirds means that there is 1 whole (or 3 one thirds) and an additional 2 one thirds.
- The numerator of a fraction shows the count of units (the denominator).

Note

- Counting by the unit fraction with a visual representation can reinforce the relationship between the numerator and the denominator as parts of the whole. Fractions can describe amounts greater than 1 whole.
- The fewer partitions of a whole, the smaller the number of counts needed to make a whole. For example, it takes 3 counts of one third to make a whole, whereas it takes 5 counts of one fifth to make a whole.

- When the numerator is greater than the denominator (e.g., $\frac{5}{3}$), the fraction is called *improper* and can be written as a mixed number (in this case, $1\frac{2}{3}$). Understanding counts can support understanding the relationship between improper fractions and mixed numbers.
- Counting of unit fractions is implicitly the addition of unit fractions.

B1.7 Fractions and Decimals

read, represent, compare, and order decimal tenths, in various contexts

Teacher supports

Key concepts

- The place value of the first position to the right of the decimal point is tenths.
- Decimal tenths can be found in numbers less than 1 (e.g., 0.6) or more than 1 (e.g., 24.7).
- When representing a decimal tenth, the whole should also be indicated.
- Decimal tenths can be compared and ordered by visually identifying the size of the decimal number relative to 1 whole.
- Between any two consecutive whole numbers are other numbers. Decimal numbers are the way that the base ten number system shows these "in-between" numbers. For example, the number 3.6 describes a quantity between 3 and 4.
- As with whole numbers, a zero in a decimal indicates that there are no groups of that size in the number. So, 5.0 means there are 0 tenths. It is important that students understand that 5 and 5.0 represent the same amount and are equivalent.
- Writing zero in the tenths position can be an indication of the precision of a measurement (e.g., the length was exactly 5.0 cm, versus a measurement that may have been rounded to the nearest ones, such as 5 cm).
- Decimals are read in a variety of ways in everyday life. Decimals like 2.5 are commonly read as two point five; the decimal in baseball averages is typically ignored (e.g., a player hitting an average of 0.300 is said to be "hitting 300"). To reinforce the decimal's connection to fractions, and to make evident its place value, it is highly recommended that decimals be read as their fraction equivalent. So, 2.5 should be read as "2 and 5 tenths". The word "and" is used to separate the whole-number part of the number and the decimal part of the number.
- Many tools that are used to represent whole numbers can be used to represent decimal numbers. It is important that 1 whole be emphasized to see the representation in tenths

and not as wholes. For example, a base ten rod or a ten frame that was used to represent 10 wholes can be used to represent 1 whole that is partitioned into tenths.

B1.8 Fractions and Decimals

round decimal numbers to the nearest whole number, in various contexts

Teacher supports

Key concepts

- Rounding numbers is often done to estimate a quantity or a measure, to estimate the results of a computation, and to estimate a comparison.
- A decimal number rounded to the nearest whole number means rounding the number to the nearest one; for example, is 1.7 closer to 1 or 2?
- Decimal tenths are rounded based on the closer distance between two whole numbers. For example:
    - 56.2 is rounded to 56, because it is two tenths from 56 as opposed to eight tenths to 57.
- If a decimal tenth is exactly between two whole numbers, the convention is to round up, unless the context suggests differently – in some circumstances, it might be better to round down.

Note

- As with whole numbers, rounding decimal numbers involves making decisions about the level of precision needed. Whether a number is rounded up or down depends on the context and whether an overestimate or an underestimate is preferred.

B1.9 Fractions and Decimals

describe relationships and show equivalences among fractions and decimal tenths, in various contexts

Teacher supports

Key concepts

- The fraction $\frac{1}{10}$ as a quotient is 1 ÷ 10 and the result is 0.1, which is read as one tenth.
- A count of decimal tenths is the same as a count of unit fractions of one tenth and can be expressed in decimal notation (i.e., 0.1 (1 one tenth), 0.2 (2 one tenths), 0.3 (3 one tenths), and so on).
- A count of 10 one tenths makes 1 whole and can be expressed in decimal notation (1.0).
- A count by tenths can be greater than 1 whole. For example, 15 tenths is 1 whole and 5 tenths and can be expressed in decimal notation as 1.5.

B2. Operations

use knowledge of numbers and operations to solve mathematical problems encountered in everyday life

Specific expectations

By the end of Grade 4, students will:

B2.1 Properties and Relationships

use the properties of operations, and the relationships between addition, subtraction, multiplication, and division, to solve problems involving whole numbers, including those requiring more than one operation, and check calculations

Teacher supports

Key concepts

- The commutative property holds true for addition and for multiplication. The order of the numbers does not matter; the results will be the same. For example, 4 + 6 = 6 + 4 and 4 × 6 = 6 × 4.
- The associative property holds true for addition and for multiplication. The pairs of numbers that are added first or multiplied first does not matter; the results will be the same. For example, (2 + 3) + 5 = 2 + (3 + 5). Similarly, (2 × 3) × 5 = 2 × (3 × 5).
- The distributive property can be used to determine the product of two numbers. For example, to determine 8 × 7 one can rewrite 8 as 5 and 3 and find the sum of the

products for 5 × 7 and 3 × 7 (i.e., 8 × 7 = (5 + 3) × 7 which equals (5 × 7) + (3 × 7), which is 35 + 21, or 56).

- Addition and subtraction are inverse operations. Any subtraction question can be thought of as an addition question (e.g., 54 – 48 = ? is the same as 48 + ? = 54) and vice versa. This inverse relationship can be used to perform and check calculations.
- Multiplication and division are inverse operations. Any division question can be thought of as a multiplication question unless 0 is involved (e.g., 16 ÷ 2 = ? is the same as ? × 2 = 16), and vice versa. This inverse relationship can be used to perform and check calculations.
- Sometimes a property may be used to check an answer. For example, 4 × 7 may be first determined using the distributive property as (2 × 7) + (2 × 7), and then checked by decomposing (4 × 7) as (2 × 2) × 7 and using the associative property 2 × (2 × 7).
- Sometimes the reverse operation may be used to check an answer. For example, 32 ÷ 4 = 8 could be checked by multiplying 4 and 8 to determine if it equals 32.

Note

- This expectation supports many other expectations in the Number strand and is applied throughout the grade. Whether working with numbers or operations, recognizing and applying properties and relationships builds a strong foundation for doing mathematics.
- The four operations are related. Addition and subtraction strategies can be used to think about and solve multiplication and division questions (see **SEs B2.5**, **B2.6**, and **B2.7**).
- When addition is used to solve a subtraction question, this is often referred to as finding the missing addend.
- The context of a problem may influence how students think about performing the calculations.
- Operation sense involves the ability to represent situations with symbols and numbers. Understanding the meaning of the operations, and the relationships between and among them, enables one to choose the operation that most closely represents a situation and most efficiently solves the problem given the tools at hand.

B2.2 Math Facts

recall and demonstrate multiplication facts for 1 × 1 to 10 × 10, and related division facts

Teacher supports

Key concepts

- The identity principle states that when multiplying an amount by 1 or dividing an amount by 1, the amount stays the same (e.g., 5 × 1 = 5 and 5 ÷ 1=5).
- The facts of 1, 2, 5, and 10 can be used to determine the facts for other numbers. For example:

  - 2× 7 can be determined by knowing 7 × 2.
  - 7 × 3 can be determined by knowing 7 × 2 and then adding one more group of 7.
  - 7 × 4 can be determined by knowing 7 × 2 and then doubling.

- Division facts can be determined using multiplication facts (e.g., 24 ÷ 6 can be determined using the multiplication facts for 6).

Note

- Having automatic recall of multiplication and division facts is important when carrying out mental or written calculations, and frees up working memory when solving complex problems and tasks.
- The development of the other facts using the facts for 1, 2, 5, and 10 is based on the commutative, distributive, or associative properties and in being able to decompose numbers. For example:

  - 2 × 7 can be determined by knowing 7 × 2 (commutative property).
  - 7 × 3 can be determined by knowing 7 × 2 and then adding one more group of 7 (decomposing and using the distributive property).
  - 7 × 4 can be determined by knowing 7 × 2 and then doubling (decomposition and associative property).
  - 7 × 6 can be determined by knowing 7 × 5 and adding one more 7.
  - 7 × 9 can be determined by knowing 7 × 10 and taking away 7.

- The array can be used to model multiplication and division because it structures repeated groups of equal size into rows and columns.

  - In a multiplication situation, the number of rows and columns for the array are known.
  - In a division situation, the total number of objects is known, as well as either the number of rows or the number of columns. In order to create an array to represent a division situation, the objects are arranged into the rows or columns that are known until all the objects have been distributed evenly.

- A strategic approach to learning multiplication and division facts recognizes that some facts are foundational for learning other facts. Although the precise order might differ and different strategies are certainly possible, researchers tend to suggest learning facts in related clusters. For example:
    - Foundational facts: 2-facts, 5-facts, 10-facts.
    - Near facts: 3-facts, 6-facts, 9-facts (using 2-facts, 5-facts, and 10-facts and adding or subtracting a group).
    - Doubles: 4-facts, 6-facts (doubling strategies); 8-facts (doubling a double).
    - Adding or subtracting doubles: 8-facts, 7-facts.
- Practice is important for moving from understanding to automaticity. Focusing on one set of number facts at a time (e.g., the 6-facts) and related facts (5-facts or 3-facts) is a useful strategy for building mastery.

B2.3 Mental Math

use mental math strategies to multiply whole numbers by 10, 100, and 1000, divide whole numbers by 10, and add and subtract decimal tenths, and explain the strategies used

Teacher supports

Key concepts

- Multiplying a whole number by 10 can be visualized as shifting of the digit(s) to the left by one place. For example, 5 × 10 = 50; 50 × 10 = 500; 500 × 10 = 5000.
- Multiplying a whole number by 100 can be visualized as shifting of the digit(s) to the left by two places. For example, 5 × 100 = 500; 50 × 100 = 5000; 500 × 100 = 50 000.
- Mentally multiplying a whole number by 1000 can be visualized as a shifting of the digit(s) to the left by three places. For example, 5 x 1000 = 5000; 50 × 1000 = 50 000; 500 × 1000 = 500 000.
- Mentally dividing a whole number by 10 can be visualized as a shifting of the digit(s) to the right by one place, since the value of the numbers will be one tenth of what they were. For example, 5000 ÷ 10 = 500, 500 ÷ 10 = 50, 50 ÷ 10 = 5, 5 ÷ 10 = 0.5.
- Mental math strategies for addition and subtraction of whole numbers can be used with decimal numbers.
- To mentally add and subtract decimal numbers, the strategies may vary depending on the numbers given. For example:

    - If given 44.9 + 31.9, one could round both numbers to 45 and 32 to make 77 and then remove 0.1 twice from the rounding, to make 76.8.
    - If given 34.6 + 42.5, one could first make 1 by combining the 0.5 from both of the numbers, then add it to 34 to make 35. Next add 40 from 42 onto the 35 to make 75. Then add on the remaining numbers 2 and 0.1 to make 77.1.

Note

- Mental math may or may not be quicker than paper-and-pencil strategies, but speed is not the goal. The value of mental math is in its portability and flexibility, since it does not require a calculator or paper and pencil. Practising mental math strategies also deepens an understanding of numbers.
- Mental math involves using flexible strategies that build on basic facts, number relationships, and counting strategies. These strategies continue to expand and develop through the grades.
- When mentally adding and subtracting decimals – or anything – the unit matters. Only like units are combined. For example, hundreds are combined with hundreds, tens with tens, ones with ones, and tenths with tenths.
- Estimation can be used to check the reasonableness of calculations and should be continually encouraged when students are doing mathematics.

B2.4 Addition and Subtraction

represent and solve problems involving the addition and subtraction of whole numbers that add up to no more than 10 000 and of decimal tenths, using appropriate tools and strategies, including algorithms

Teacher supports

Key concepts

- Situations involving addition and subtraction may involve:
    - adding a quantity onto an existing amount or removing a quantity from an existing amount;
    - combining two or more quantities;
    - comparing quantities.
- There are a variety of tools and strategies that can be used to add and subtract numbers, including decimal tenths:

- Acting out a situation, by representing it with objects, a drawing, or a diagram, can help support students in identifying the given quantities in a problem and the unknown quantity.
- Set models can be used to add a quantity to an existing amount or removing a quantity from an existing amount.
- Linear models can be used to determine the difference between two quantities by comparing them visually.
- Part-whole models can be used to show the relationship between what is known and what is unknown and how addition and subtraction relate to the situation.

Note

- An important part of problem solving is the ability to choose the operation that matches the action in a situation. For additive situations – situations that involve addition or subtraction – there are three "problem structures":
  - *Change* situations, where one quantity is changed, by having an amount either *joined* to it or *separated* from it. Sometimes the result is unknown; sometimes the starting point is unknown; sometimes the change is unknown.
  - *Combine* situations, where two quantities are *combined*. Sometimes one part is unknown; sometimes the other part is unknown; sometimes the result is unknown.
  - *Compare* situations, where two quantities are being *compared*. Sometimes the larger amount is unknown; sometimes the smaller amount is unknown; sometimes the difference between the two amounts is unknown.
- The use of drawings and models, including part-whole models, helps with recognizing the actions and quantities involved in a situation. This provides insight into which operation to use and helps in choosing the appropriate equation to represent the situation.
- A variety of strategies may be used to add or subtract, including algorithms.
- An algorithm describes a process or set of steps to carry out a procedure. A standard algorithm is one that is known and used by a community. Different cultures have different standard algorithms that they use to perform calculations.
- The most common (standard) algorithms for addition and subtraction in North America use a compact organizer to *decompose* and *recompose* numbers based on place value. They begin with the smallest unit – whether it be the ones column or decimal tenths – and use regrouping or trading strategies to carry out the computation. (See **Grade 3, SE B2.4.**)
- When carrying out an addition or subtraction algorithm, only common units can be combined or separated. This is particularly noteworthy when using the North American standard algorithms with decimals numbers because unlike with whole numbers, the smallest unit in a number is not always common (e.g., 90 − 24.7). In this case, the number

90 can be changed to 90.0 so that the units can more easily be aligned; that is, 0 is used as a placeholder.

- Making explicit the compactness and efficiency of the standard algorithm strengthens understanding of place value and the properties of addition and subtraction.

How It Is Written		What It Means
$\overset{8}{\cancel{9}}\overset{9}{\cancel{0}}.\overset{1}{\cancel{0}}$	➡	(80.0 + 9.0 + 1.0)
– 24.7	➡	– (20.0 + 4.0 + 0.7)
65.3	➡	60.0 + 5.0 + 0.3

B2.5 Multiplication and Division

represent and solve problems involving the multiplication of two- or three-digit whole numbers by one-digit whole numbers and by 10, 100, and 1000, using appropriate tools, including arrays

Teacher supports

Key concepts

- Situations involving multiplication include:
  - groups of equal quantity – involves determining the total quantity given the number of equal groups and the size of each group;
  - scale factor – involves changing the size of an initial quantity;
  - area – involves a multiplication of two linear measures;
  - combinations – involves determining the total number of combinations of two or more things.
- A variety of tools and strategies can be used to represent multiplication problems:
  - Acting out a situation, by representing it with objects, a drawing, or a diagram, can help to identify the given quantities in a problem and the quantity.
  - The array can be used to represent groups of equal quantity.
  - A double number line can be used to represent scaling.
  - Rectangular grids can be used to represent area measures.
  - A tree diagram can be used to represent various combinations.

Note

- The numbers that are multiplied together are called factors. The result of a multiplication is called the product.
- Situations involving multiplication include:
  - repeated equal groups (see **Grade 2, B2.5**);
  - scale factor – ratio comparisons, rates and scaling (see **SEs B1.5** and **B2.8** and **Grade 3, SE B2.9**);
  - area and other measurements (see **Spatial Sense, SEs E2.5** and **E2.6**);
  - combinations of attributes.
- The array can be a model for showing multiplication and division because it structures repeated groups of equal size into rows and columns (see **Spatial Sense, E2.5**). The array makes visual connections to skip counting, the distributive property, the inverse relationship between multiplication and division, and the measurement of area.
- A double number line can be used to show the comparison between the original amount (one number line) and the scaled amount (another number line).
- A grid showing a rectangle partitioned vertically and horizontally can be used to show the decomposition of two factors and the sum of these parts.

B2.6 Multiplication and Division

represent and solve problems involving the division of two- or three-digit whole numbers by one-digit whole numbers, expressing any remainder as a fraction when appropriate, using appropriate tools, including arrays

Teacher supports

Key concepts

- Situations involving division include:
  - groups of equal quantity – involves determining either the number of groups or the size of each group;
  - scale factor – involves determining either the original quantity or the value that the original value was multiplied by;
  - area – involves determining the value of either linear measure;
  - combinations – involves determining the number of possible values of one attribute or the other.

- A variety of tools and strategies can be used to represent division problems:
  - Acting out a situation, by representing it with objects, a drawing, or a diagram, can help identify the given quantities in a problem and the unknown quantity that needs to be determined.
  - The array can be used to represent groups of equal quantity.
  - A double number line can be used to represent scaling.
  - Rectangular grids can be used to represent area measures.
  - A tree diagram can be used to represent various combinations.

Note

- Multiplication and division are inverse operations (see **SE B2.1**).
  - The numbers that are multiplied together are called factors. The result of a multiplication is called the product.
  - When a multiplication statement is rewritten as a division statement, the product is referred to as the dividend, one of the factors is the divisor, and the other factor is the quotient (result of division).

- Situations involving multiplication and division include:
  - repeated equal groups (see **Grade 2, SE B2.5**);
  - scale factor – ratio comparisons, rates, and scaling (see **SEs B1.5** and **2.8** and **Grade 3, SE B2.9**);
  - area and other measurements (see **Spatial Sense, SEs E2.5** and **E2.6**);
  - combinations.

- When an array is used to represent division, the total quantity is given, and one of the factors (which can be either a row or column of the array). The total quantity is equally divided among these rows or columns.
- When a double number line is used to represent a division in which the original and new quantities are known, one needs to determine the scale factor that is used to go from the original number line to the new one.
- When a rectangle is used to represent division, and the total number of 1-unit squares and one dimension are known, one needs to arrange the unit squares into a rectangle that has the given dimension.
- For each division situation, there are two division types:
  - equal-sharing division (also called “partitive division”):
    - *What is known:* the *total* and *number* of groups.

        - *What is unknown:* the *size* of the groups.
        - *The action:* a total shared equally among a given number of groups.

- See **SE B1.5** for connections between equal-sharing division and fractions.

    - equal-grouping division (also called "measurement division" or "quotative division"):

        - *What is known:* the *total* and the *size* of groups.
        - *What is unknown:* the *number* of groups.
        - *The action:* from a total, equal groups of a given size measured out.

- Division does not always result in whole number amounts. The real-life situation determines whether the fraction is rounded up or rounded down or remains a fraction. For example:

    - 17 items shared among 5 (i.e., 17 ÷ 5) means each receives 3 items and $\frac{2}{5}$ of another item.
    - 17 people needing to go in cars that hold 5 people means that 3 cars are needed for 15 of them, plus another car is needed for the remaining 2, so 4 cars are needed in all.
    - Determining how many $5 items can be bought with $17 means that 3 items can be purchased; there is not enough money for the fourth item.

B2.7 Multiplication and Division

represent the relationship between the repeated addition of a unit fraction and the multiplication of that unit fraction by a whole number, using tools, drawings, and standard fractional notation

Teacher supports

Key concepts

- The numerator in a fraction describes the count of unit fractions. So, 4 one thirds (four thirds) is written in standard fractional form as $\frac{4}{3}$.
- There is a relationship between the repeated addition of a unit fraction, the multiplication of that unit fraction, and standard fractional notation:

    - 4 one thirds (four thirds).can be represented as $\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}=4\times\frac{1}{3}$ or $\frac{4}{3}$

Note

- It is important that students recognize the connection between counting unit fractions (see **SE B1.6**), repeated addition and multiplication of unit fractions, and the meaning of the numerator (see **SE B1.4**).
- As students come to associate multiplication with the count (the numerator) and division with the unit size (the denominator), they come to understand the standard fractional notation and its connection to the operations of multiplication and division.

B2.8 Multiplication and Division

show simple multiplicative relationships involving whole-number rates, using various tools and drawings

Teacher supports

Key concepts

- A rate describes the multiplicative relationship between two quantities expressed with different units (e.g., bananas per dollar; granola bars per child; kilometres per hour).
- A rate can be expressed in words, such as 50 kilometers per hour.
- A rate can be expressed as a division statement, such as 50 km/h.
- There are many applications for rates in real life.

Note

- Like ratios, rates make comparisons based on multiplication and division; however, rates compare two related but different measures or quantities. For example, if 12 cookies are eaten by 4 people, then the rate is 12 cookies per 4 people. An equivalent rate is 6 cookies per 2 people. A unit rate is 3 cookies per person.

C. Algebra

Overall expectations

By the end of Grade 4, students will:

C1. Patterns and Relationships

identify, describe, extend, create, and make predictions about a variety of patterns, including those found in real-life contexts

Specific expectations

By the end of Grade 4, students will:

C1.1 Patterns

identify and describe repeating and growing patterns, including patterns found in real-life contexts

Teacher supports

Key concepts

- The complexity of a repeating pattern depends on:
  - the nature of the attribute(s);
  - the number of changing attributes;
  - the number of elements in the core of the pattern;
  - the number of changing elements within the core.
- In growing patterns, there is an increase in the number of elements or the size of the elements from one term to the next.

Note

- Students can engage in mathematics and patterns through the contexts, cultural histories, and stories of various cultures.

C1.2 Patterns

create and translate repeating and growing patterns using various representations, including tables of values and graphs

Teacher supports

Key concepts

- The same pattern structure can be represented in various ways.
- Repeating patterns can vary in complexity, but all are created by iterating their pattern core.
- Growing patterns are created by increasing the number of elements in each iteration.
- When translating a pattern from a concrete representation to a table of values, each iteration of the pattern can be referred to as the term number, and the number of elements in each iteration can be referred to as the term value. In a table of values, the term number is shown in the left-hand column and the term value is shown in the right-hand column.
- The term value is dependent on the term number. The term number (x) is represented on the horizontal axis of the Cartesian plane, and the term value (y) is represented on the vertical axis. Each point (x, y) on the Cartesian plane is plotted to represent the pattern.

Note

- The creation of growing patterns in this grade is not limited to linear patterns.
- For (x, y), the x-value is the independent variable and the y-value is the dependent variable.
- Comparing translated patterns highlights the equivalence of their underlying mathematical structure, even though the representations differ.

C1.3 Patterns

determine pattern rules and use them to extend patterns, make and justify predictions, and identify missing elements in repeating and growing patterns

Teacher supports

Key concepts

- Patterns can be extended because they are repetitive by nature.

- Pattern rules are generalizations about a pattern, and they can be described in words.
- Patterns can be extended in multiple directions – up, down, right, left, diagonally.
- To make a near prediction about a pattern is to state or show what a pattern will look like just beyond the given representation of that pattern. The prediction can be verified by extending the pattern.
- To make a far prediction about a pattern is to state or show what a pattern will look like well beyond the given representation of that pattern. Often calculations are needed to make an informed prediction or to verify a prediction.
- To identify missing elements of patterns is to complete a representation for a given pattern by filling in the missing parts.

Note

- In order to extend, predict, or determine missing elements, students need to generalize patterns, using pattern rules.
- Rules should be used to verify predictions and to critically analyse extensions and solutions for missing elements.

C1.4 Patterns

create and describe patterns to illustrate relationships among whole numbers and decimal tenths

Teacher supports

Key concepts

- Patterns can be used to understand relationships between whole numbers and decimal numbers.

Note

- Many number strings are based on patterns and the use of patterns to develop a mathematical concept.

C2. Equations and Inequalities

demonstrate an understanding of variables, expressions, equalities, and inequalities, and apply this understanding in various contexts

Specific expectations

By the end of Grade 4, students will:

C2.1 Variables

identify and use symbols as variables in expressions and equations

Teacher supports

Key concepts

- Symbols can be used to represent quantities that change or quantities that are unknown.
- An expression is a mathematical statement that involves numbers, letters, and/or operations, for example, $a + 3$.
- An equation is a statement of equality between two expressions, for example, $1a + 3 = 5 + 10$.
- Formulas are a type of equation, for example, $A = b \times h$.
- Quantities that can change are also referred to as “variables”.
- Quantities that remain the same are also referred to as “constants”.

Note

- Identifying quantities in real life that stay the same and those that can change will help students understand the concept of variability.
- Identifying what is constant and what changes is one of the aspects of mathematical modelling.
- In mathematics notation, variables are only expressed as letters or symbols. When coding, variables may be represented as words, abbreviated words, symbols, or letters.
- In an expression like $4a$, it is understood that the operation between the 4 and the a is multiplication. In working with some technologies, $4a$ would need to be inputted as 4*a, in which the asterisk denotes multiplication. The forward slash (/) is used for division.

C2.2 Equalities and Inequalities

solve equations that involve whole numbers up to 50 in various contexts, and verify solutions

Teacher supports

Key concepts

- Equations are mathematical statements such that the expressions on both sides of an equal sign are equivalent.
- In equations, symbols are used to represent unknown quantities.

Note

- To solve an equation using guess-and-check, the process is iterative. The unknown value is estimated and then tested. Based on the result of the test, the guess is refined to get closer to the actual value.
- To solve an equation using a balance model, the expressions are visually represented and are manipulated until they are equivalent.

C2.3 Equalities and Inequalities

solve inequalities that involve addition and subtraction of whole numbers up to 20, and verify and graph the solutions

Teacher supports

Key concepts

- Inequalities can be solved as equations, but the values that result must be tested to determine if they hold true for the inequality.
- A number line shows the range of values that hold true for an inequality. An open dot on a number line is used when an inequality involves “less than” or “greater than”, and a closed dot is used when it also includes “equal to”.
- Number lines help students notice the range of values that hold true for inequalities.

C3. Coding

solve problems and create computational representations of mathematical situations using coding concepts and skills

Specific expectations

By the end of Grade 4, students will:

C3.1 Coding Skills

solve problems and create computational representations of mathematical situations by writing and executing code, including code that involves sequential, concurrent, repeating, and nested events

Teacher supports

Key concepts

- A loop is used to control a structure that allows for a sequence of instructions to be repeated.
- Loops make the code more readable and reduce the number of instructions that need to be written.
- Loops can be used to repeat steps or tasks that occur more than once in an algorithm or solution.
- Loops can exist within loops, referred to as “nested loops”.

Note

- Coding can support students in developing a deeper understanding of mathematical concepts.
- Coding can include a combination of pseudocode, block-based coding programs, and text-based coding programs.
- Students can program for various agents, such as a pixelated image on a screen, a classmate acting out the code when appropriate, or a physical device (e.g., robot, microcontroller).

C3.2 Coding Skills

read and alter existing code, including code that involves sequential, concurrent, repeating, and nested events, and describe how changes to the code affect the outcomes

Teacher supports

Key concepts

- Code can be simplified by using loops or by combining steps and operations.
- Reading code is done to make a prediction about what the expected outcome will be. Based on that prediction, one can determine if the code needs to be altered prior to its execution.
- Code must sometimes be altered so that the expected outcome can be achieved.
- Code can be altered to be used for a new situation.

Note

- Using loops helps students organize their code and provides a foundation for considering efficiencies in program solutions.
- By manipulating conditions within a loop and the number of times the loop is repeated, students can determine the relationship between variables in lines of code and can explore math concepts, such as pattern intervals and terms.

C4. Mathematical Modelling

apply the process of mathematical modelling to represent, analyse, make predictions, and provide insight into real-life situations

This overall expectation has no specific expectations. Mathematical modelling is an iterative and interconnected process that is applied to various contexts, allowing students to bring in learning from other strands. Students' demonstration of the process of mathematical modelling, as they apply concepts and skills learned in other strands, is assessed and evaluated.

Read more about the mathematical modelling process.

Teacher supports

Key concepts

- The process of mathematical modelling requires: understanding the problem; analysing the situation; creating a mathematical model; and analysing and assessing the model.

Note

- A mathematical modelling task is different from a real-life application due to the cyclic nature of modelling, which involves examining a problem from outside mathematics, modelling it, and then checking the model back against the real-life situation and adjusting as necessary.
- The process of mathematical modelling should not be confused with using a "model" to represent or solve a problem that does not require the whole process.
- Mathematical modelling tasks can be utilized in many ways and can support students with making connections among many mathematical concepts across the math strands and across other curricula.

D. Data

Overall expectations

By the end of Grade 4, students will:

D1. Data Literacy

manage, analyse, and use data to make convincing arguments and informed decisions, in various contexts drawn from real life

Specific expectations

By the end of Grade 4, students will:

D1.1 Data Collection and Organization

describe the difference between qualitative and quantitative data, and describe situations where each would be used

Teacher supports

Key concepts

- It is important to know whether the data that is needed to answer a question is qualitative or quantitative, so that appropriate collection can be planned and carried out, appropriate representations chosen, and appropriate analysis conducted.

- Qualitative data involves variables that can be placed into categories like “type of sports” or “colour”.
- Quantitative data involves variables that can be counted or ordered, like “the number of legs on an insect” or “the length of an object”.

D1.2 Data Collection and Organization

collect data from different primary and secondary sources to answer questions of interest that involve comparing two or more sets of data, and organize the data in frequency tables and stem-and-leaf plots

Teacher supports

Key concepts

- The type and amount of data to be collected is based on the question of interest. Data can either be qualitative or quantitative. Sometimes more than one data set is needed to answer a question of interest.
- Data may need to be collected from a primary source through observations, experiments, interviews, or written questionnaires, or from a secondary source that has already collected the data, such as Statistics Canada or the school registry.
- Two or more data sets can be organized in separate frequency tables or within the same frequency table.
- A stem-and-leaf plot is one way to organize quantitative data. It can provide a sense of the shape of the data. The digits in the number are separated out into a stem and a leaf. For example, the number 30 has a stem of 3 and a leaf of 0. The stems and the leaves are ordered from least to greatest value in the plot.

Stem	Leaf
0	5 5
1	0 0 0 5 5 5 5
2	0 0 5 5
3	0 5 5 5

Key: 3|0 is 30 minutes

D1.3 Data Visualization

select from among a variety of graphs, including multiple-bar graphs, the type of graph best suited to represent various sets of data; display the data in the graphs with proper sources, titles, and labels, and appropriate scales; and justify their choice of graphs

Teacher supports

Key concepts

- Multiple bar graphs show comparisons. They have bars in which data sets are shown side by side to compare two aspects of the data.
- Multiple bar graphs can be created in more than one way, including with horizontal and vertical bars.
- The source, titles, labels, and scales provide important information about the data in a graph or table:
  - The source indicates where the data was collected.
  - The title introduces the data shown in the graph or table.
  - Labels provide additional information, such as the labels on the axes of a graph describe what is being measured (the variable).
  - Scales are indicated on the axis showing frequencies in bar graphs and in the key of pictographs.

Note

- The numerical values of the frequencies need to be considered when a scale is chosen.
- Depending on the scale that is chosen, the length of the bars on a bar graph may need to be estimated.

D1.4 Data Visualization

create an infographic about a data set, representing the data in appropriate ways, including in frequency tables, stem-and-leaf plots, and multiple-bar graphs, and incorporating any other relevant information that helps to tell a story about the data

Teacher supports

Key concepts

- Infographics are used to share data and information on a topic, in an appealing way.
- Infographics contain different representations of the data, such as tables, plots, and graphs, and minimal text.
- Information to be included in an infographic needs to be carefully considered so that it is clear and concise.
- Infographics tell a story about the data with a specific audience in mind.

Note

- Creating infographics has applications in other subject areas, such as communicating key findings and messages in STEM projects.

D1.5 Data Analysis

determine the mean and the median and identify the mode(s), if any, for various data sets involving whole numbers, and explain what each of these measures indicates about the data

Teacher supports

Key concepts

- The mean, median, and mode can be determined for quantitative data. Only the mode can be determined for qualitative data.
- The mean is calculated by adding up all of the values of a data set and then dividing that sum by the number of values in the set.
- The median is the middle data value for an ordered list. If there is an even number of data values, then the median is the mean of the two middle values in the ordered list.
- A variable can have one mode, multiple modes, or no mode.

Note

- The mean, median, and mode are the three measures of central tendency.

D1.6 Data Analysis

analyse different sets of data presented in various ways, including in stem-and-leaf plots and multiple-bar graphs, by asking and answering questions about the data and drawing conclusions, then make convincing arguments and informed decisions

Teacher supports

Key concepts

- Different representations are used for different purposes to convey different types of information.
- Stem-and-leaf plots are helpful for quickly determining highest and lowest values, as well as the mode and median for a set of data.
- Multiple-bar graphs are used to organize data sets side by side and allow for easy comparisons between the sets of data.
- Data presented in tables, plots, and graphs can be used to ask and answer questions, draw conclusions, and make convincing arguments and informed decisions.
- Questions of interest are intended to be answered through the analysis of the representations. Sometimes the analysis raises more questions that require further collection, representation, and analysis of data.

Note

- There are three levels of graph comprehension that students should learn about and practise:
    - Level 1: information is read directly from the graph and no interpretation is required.
    - Level 2: information is read and used to compare (e.g., greatest, least) or perform operations (e.g., addition, subtraction).
    - Level 3: information is read and used to make inferences about the data using background knowledge of the topic.
- As graphs become more sophisticated, have students highlight the parts of the graph they need to answer a question, including the scales when appropriate.

D2. Probability

describe the likelihood that events will happen, and use that information to make predictions

Specific expectations

By the end of Grade 4, students will:

D2.1 Probability

use mathematical language, including the terms "impossible", "unlikely", "equally likely", "likely", and "certain", to describe the likelihood of events happening, represent this likelihood on a probability line, and use it to make predictions and informed decisions

Teacher supports

Key concepts

- Probability has a continuum from impossible to certain with the following benchmarks between: unlikely, equally likely, and likely.

Note

- Sometimes equally likely is thought of as an equal chance of events happening (e.g., rolling a 4 or rolling a 6 on a single die). However, on a probability line equally likely is the probability that an event will happen half of the time (e.g., rolling an even number with a single die).

D2.2 Probability

make and test predictions about the likelihood that the mean, median, and mode(s) of a data set will be the same for data collected from different populations

Teacher supports

Key concepts

- Data can vary from one population to another.
- If two populations are similar, the modes for the two data sets collected will more than likely be the same and the means and the medians will be relatively close.

E. Spatial Sense

Overall expectations

By the end of Grade 4, students will:

E1. Geometric and Spatial Reasoning

describe and represent shape, location, and movement by applying geometric properties and spatial relationships in order to navigate the world around them

Specific expectations

By the end of Grade 4, students will:

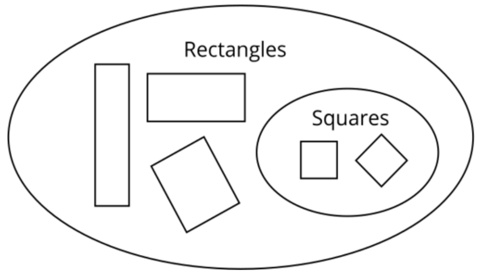
E1.1 Geometric Reasoning

identify geometric properties of rectangles, including the number of right angles, parallel and perpendicular sides, and lines of symmetry

Teacher supports

Key concepts

- Geometric properties are specific attributes that define a class of shapes or objects. The geometric properties of a rectangle describe the attributes that all rectangles have, and include:
    - four sides, four vertices, and four right angles;
    - opposite sides that are of equal length (congruent);
    - opposite sides that are parallel;
    - adjacent sides that are perpendicular;
    - at least two lines of symmetry – horizontal and vertical.
- Geometric properties are often related. Rectangles have four right angles, so they must also have two sets of parallel sides, and the opposite sides must be of equal length. This type of spatial reasoning is used by structural engineers and others.
- The geometric properties of a square include all the geometric properties of a rectangle; therefore, all squares are also rectangles. Squares have additional geometric properties (four equal sides, four lines of symmetry, including two diagonals), therefore not all rectangles are squares.



- The geometric properties of a shape, and not its size or orientation, define the name of a shape. A rotated square that might look like a diamond is still a square, because it has all the geometric properties of a square.

E1.2 Location and Movement

plot and read coordinates in the first quadrant of a Cartesian plane, and describe the translations that move a point from one coordinate to another

Teacher supports

Key concepts

- The Cartesian plane uses two perpendicular number lines to describe locations on a grid. The *x*-axis is a horizontal number line, the *y*-axis is a vertical number line, and these two number lines intersect at the origin, (0, 0).
- The number lines on the Cartesian plane extend infinitely in all four directions and include both positive and negative numbers, which are centred by the origin, (0, 0). In the first quadrant of the Cartesian plane, the *x*- and *y*-coordinates are positive.
- Pairs of numbers (coordinates) describe the precise location of any point on the plane. The coordinates are enclosed by parentheses as an ordered pair. The first number in the pair describes the horizontal distance from the origin, and the second number describes the vertical distance from the origin. The point (1, 5) is located 1 unit to the right of the origin (along the *x*-axis) and 5 units above the *x*-axis). As a translation from (0, 0), the point (1, 5) is right 1 unit and up 5 units.

Note

- An understanding of the Cartesian plane supports work in geometry, measurement, Algebra, and Data, as well as practical applications such as navigation, graphic design, engineering, astronomy, and computer animation.

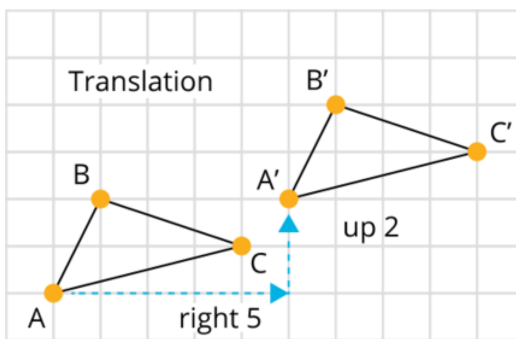
E1.3 Location and Movement

describe and perform translations and reflections on a grid, and predict the results of these transformations

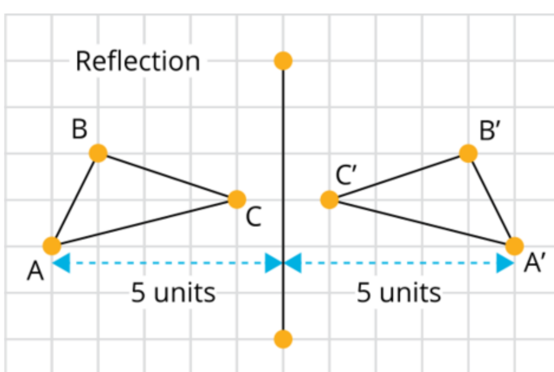
Teacher supports

Key concepts

- Transformations on a shape result in changes to its position or its size. As a shape transforms, its vertices (points on a grid) move. This explains how transformations involve location and movement.
- A translation involves distance and direction. Every point on the original shape "slides" the same distance and direction to create a translated image. This is called the translation vector. For example, on a grid, a vector could describe each point moving "5 units to the right and 2 units up". It is a mathematical convention that the horizontal distance (x) is given first, followed by the vertical distance (y).



- A reflection involves a line of reflection that acts like a mirror. Every point on the original shape is "flipped" across the line of reflection to create a reflected image. The points on the original image are the same distance from the line of reflection as the points on the reflected image. Reflections are symmetrical.



Note

- Online dynamic geometry applications enable students to see how transformations behave in real time and are recommended tools for the study of transformation and movement.

E2. Measurement

compare, estimate, and determine measurements in various contexts

Specific expectations

By the end of Grade 4, students will:

E2.1 The Metric System

explain the relationships between grams and kilograms as metric units of mass, and between litres and millilitres as metric units of capacity, and use benchmarks for these units to estimate mass and capacity

Teacher supports

Key concepts

- Millilitres and litres are standard metric units of capacity. Grams and kilograms are metric units of mass:
    - 1 kilogram (kg) is equivalent to 1000 grams (g).
    - 1 litre (L) is equivalent to 1000 millilitres (mL).
    - 1 mL of water has a mass of 1 g.
    - 1 mL of liquid occupies the space of a 1 cm cube.

- Although standard and non-standard units are equally accurate for measuring (provided the measurement itself is carried out accurately), *standard* units allow people to communicate distances and lengths in ways that are consistently understood.
- The metric system is universally used among scientists because it uses standard prefixes for measurements and conversions. Metric units are the standard unit for all but three countries in the world.

Note

- Canada officially adopted the metric system in 1970, through the Weights and Measures Act. This Act was amended in 1985 to allow Canadians to use a combination of metric and imperial units (called “Canadian” units in the Weights and Measures Act). In addition to metric units, other commonly used units of capacity are gallons, quarts, cups, tablespoons, and teaspoons; other commonly used units of mass are ounces, pounds, and tons. Measuring with imperial units follows the same process as measuring with metric and non-standard units. Only the units and the measuring tools differ. Imperial units are the typical units used in construction and the trades. Students in elementary grades learn to work with metric units first.

E2.2 The Metric System

use metric prefixes to describe the relative size of different metric units, and choose appropriate units and tools to measure length, mass, and capacity

Teacher supports

Key concepts

- The metric system parallels the base ten number system. One system can reinforce and help with visualizing the other system.
- The same set of metric prefixes is used for all attributes (except time) and describes the relationship between the units. For any given unit, the next largest unit is 10 times its size, and the next smallest unit is one-tenth its size.

Note

- Although not all metric prefixes are used commonly in Canada, understanding the system reinforces the connection to place value.

E2.3 Time

solve problems involving elapsed time by applying the relationships between different units of time

Teacher supports

Key concepts

- Elapsed time describes how much time has passed between two times or dates. Clocks and calendars are used to measure and/or calculate elapsed time.
- Addition, subtraction, and different counting strategies can be used to calculate the difference between two dates or times. Open number lines (time lines) can be used to track the multiple steps and different units used to determine elapsed time.

Note

- Elapsed time problems often involve moving between different units of time. This requires an understanding of the relationships between units of time (years, months, weeks, days, hours, minutes, seconds), including an understanding of a.m. and p.m. as conventions to convert the 24-hour clock into a 12-hour clock.

E2.4 Angles

identify angles and classify them as right, straight, acute, or obtuse

Teacher supports

Key concepts

- The rays that form an angle (i.e., the “arms” of an angle) meet at a vertex. The size of an angle is not affected by the length of its arms.
- A right angle is a quarter turn, and it is sometimes called a “square angle” because all angles of a square (or rectangle) are right. If two lines meet at a right angle, the lines are perpendicular.
- Angles can be compared by overlaying one angle on another and matching them. A turn greater than a right angle is an obtuse angle. A turn less than a right angle is an acute angle. A half turn, where the arms of the angle create a straight line, is a straight angle.
- Right angles measure exactly 90°, a fact that will be addressed formally in Grade 5.

E2.5 Area

use the row and column structure of an array to measure the areas of rectangles and to show that the area of any rectangle can be found by multiplying its side lengths

Teacher supports

Key concepts

- To measure the area of a rectangle, it must be completely covered by units of area (square units), without gaps or overlaps. The alignment of square units produces the rows and columns of an array, with the same number of units in each row.
    - The array replaces the need to count individual units and makes it possible to calculate an area.
    - Both the number of units in each row and the number of units in a column can be determined from the length of the rectangle's sides.
- Thinking about a row or a column as "a group that is repeated" (unitized) connects the array to multiplication: the base of a rectangle corresponds to the number of squares in a row and the height of a rectangle corresponds to the number of squares in a column.
- Multiplying the base of a rectangle by its height is a way to indirectly measure the area of a rectangle, meaning it is no longer necessary to count all the individual square units that cover a rectangle's surface.

Note

- Many students do not immediately recognize the row-and-column structure of an array; instead, it appears as a random scattering of squares, or a "spiral" of squares that goes around the outside towards the centre. Recognizing an array's structure requires careful attention and instruction.

E2.6 Area

apply the formula for the area of a rectangle to find the unknown measurement when given two of the three

Teacher supports

Key concepts

- The formula for finding the area of a rectangle can be generalized to describe the relationship between a rectangle's side lengths and its area: A = *base* × *height* (or $b \times h$).
- Both multiplication and division can be used to solve problems involving the area of a rectangle.

- Multiplication is used to determine the unknown area when the base and height of a rectangle are given (*Area* = *base* × *height*).
- Division is used to determine either the length of the base or the length of the height when the total area is given (*Area* ÷ *base* = *height*; *Area* ÷ *height* = *base*).
- Either side length can be considered the base or the height of a rectangle.

- An area measurement needs to include both the number of units and the size of the units. Standard metric units of area are the square centimetre (cm^2) and the square metre (m^2). If a surface is completely covered by 18 square centimetres, the area of that surface is 18 cm^2. If a surface is completely covered by 18 unit squares, the area of that surface is 18 square units.

Note

- The area of a rectangle is used to determine the area formulas for other polygons. Using “base” and “height” rather than “length” and “width” builds a unifying foundation for work in Grade 5 involving the area formulas for triangles and parallelograms.

F. Financial Literacy

Overall expectations

By the end of Grade 4, students will:

F1. Money and Finances

demonstrate the knowledge and skills needed to make informed financial decisions

Specific expectations

By the end of Grade 4, students will:

F1.1 Money Concepts

identify various methods of payment that can be used to purchase goods and services

Teacher supports

Key concepts

- Consumers have a choice of method of payment when purchasing goods and services.
- There is an underlying agreement between the vendor and consumer that is finalized when a payment is made.

Note

- Depending on individual circumstances and context as well as consumers' and vendors' preferences, ideas about which payment method is best in each situation will vary.
- Recognizing how people pay for goods and services helps to develop consumer awareness and an understanding of the factors that contribute to the choice of payment method.

F1.2 Money Concepts

estimate and calculate the cost of transactions involving multiple items priced in whole-dollar amounts, not including sales tax, and the amount of change needed when payment is made in cash, using mental math

Teacher supports

Key concepts

- Estimating and calculating the cost of cash transactions requires the application of addition, subtraction, mental math strategies, and math facts.

Note

- Real-life situations, using the cultural context of students in the class, provide opportunities to develop an understanding of the use of money.
- Providing multiple opportunities to apply mental math strategies to real-life situations will build students' ability to recall math facts, while reinforcing their knowledge and understanding of operations. These opportunities can provide meaningful contexts to practise mental math strategies in order to increase students' confidence and the accuracy of their calculations.

F1.3 Financial Management

explain the concepts of spending, saving, earning, investing, and donating, and identify key factors to consider when making basic decisions related to each

Teacher supports

Key concepts

- Every financial decision involves a trade-off – giving up something today or in the future to gain something else.

Note

- Each person, family, or community may be facing a different financial situation, and some of these financial situations may be challenging or difficult. Having a safe, respectful, and inclusive environment will ensure that all perspectives and opinions are valued and included when examining the above financial concepts.

F1.4 Financial Management

explain the relationship between spending and saving, and describe how spending and saving behaviours may differ from one person to another

Teacher supports

Key concepts

- Money can be used for spending, saving, or giving. It can be spent on things that are needed, wanted, or required. Saving and spending behaviours are impacted by a variety of factors, perspectives, and circumstances.
- An understanding of the relationship between spending and saving, and consideration of the possible trade-offs, may influence financial decision-making.
- Saving can be achieved by using less, sharing, reusing, recycling, upcycling, and/or caring for one's possessions so that they do not need to be replaced.

Note

- Each person, family, or community may be facing a different financial situation, and some of these financial situations may be challenging or difficult. Having a safe, respectful, and inclusive environment will ensure that all perspectives and opinions are valued and included when examining the relationship between saving and spending.

F1.5 Consumer and Civic Awareness

describe some ways of determining whether something is reasonably priced and therefore a good purchase

Teacher supports

Key concepts

- In order to become better-informed consumers, it is important for students to critically consider the price of the purchase they are considering, as well as different ratings, reviews, and perspectives before, making a purchase.
- The habit of thoughtfully considering and examining potential purchases helps to determine the best value for money.