Mathematics 9

All students need opportunities to learn mathematics in ways that are meaningful to them. Students need to be able to do mathematics in a 'hands on' way using a variety of tools and strategies.
In this course students will demonstrate their understanding of concepts by communicating and modelling their reasoning, and by connecting concepts they have mastered to other contexts. Students will learn through problem solving, and through the appropriate use of technology. They will become proficient with various computational procedures, both mentally and in written format.

Evaluation:
Term Work: 80%
Final Examination: 20%

The term work grade will be composed of various summative tools, including:
- assignments (10%)
- projects (10%)
- Unit tests (60%)

Evaluative tools will also include written, oral and pictorial explanations of learning that has taken place.

Different Learning Styles

LEARNING STYLE	STRENGTHS AND PREFERENCES	*MATH MAKES SENSE*
Linguistic	Reading, writing, telling stories, remembering, talking, interacting, hearing, seeing words	Provides learning opportunities to talk, discuss, explain, write, read, and see words
Logical/Mathematical	Experimenting, working with numbers, asking questions, exploring patterns and relationships, math reasoning, applying logic, problem solving, classifying	Provides learning opportunities to experiment, work with numbers, ask questions, explore patterns and relationships, reason mathematically, work with logic, solve problems, classify items
Visual/Spatial	Drawing, building, designing, creating, visualizing, imagining, working with pictures/colours, doing mazes and puzzles, reading maps and charts	Provides learning opportunities to draw, build, design, create, visualize, imagine, work with pictures/colours, do puzzles, read maps and charts
Musical	Singing, humming, noticing pitches, responding to music, playing instruments, picking up sounds/rhythms/melodies	Provides learning opportunities to work with patterns and make music connections
Kinesthetic	Moving and doing, touching and talking, feeling objects, using body language, physical activities, sports/dance, acting, making crafts, interacting with space	Provides learning opportunities to move and do, touch and talk, feel objects, use body language, work with manipulatives, make models, interact with space
Social (Interpersonal)	Talking to people, joining groups, understanding/leading others, organizing, communicating, mediating, sharing, relating, cooperating, interviewing	Provides learning opportunities to talk to people, work in groups, understand/lead others, organize, communicate, mediate, share, compare, relate, cooperate, interview
Individual (Intrapersonal)	Working alone, pursuing own interests, understanding self, focusing inward, following instincts, pursuing goals, being original, having own space, doing individual projects	Provides learning opportunities to work individually, build thinking skills, think critically, follow instincts, solve problems, find original solutions, pursue individual projects
Naturalistic	Interest in nature and the environment	Provides learning opportunities by working with objects from nature

Scope and Sequence Mathematics 7, 8, 9

Unit	Grade 7	Grade 8	Grade 9
	Investigation	Investigation	Investigation
1	Relations and Equations	Square Roots and Pythagoras' Theorem	Rational Numbers
2	Integers	Integers	Linear Equations and Inequalities
3	Fractions, Decimals, and Percent	Fractions	Graphing and Linear Relations
4	Measurement	3-D Geometry and Measurement	3-D Geometry and Measurement
	Investigation	Investigation	Investigation
5	Operations with Fractions	Ratio, Rate, and Percent	Exponents
6	Equations	Linear Equations and Graphing	Polynomials
7	Data Analysis	Data Analysis	Data Analysis
8	Geometry	Geometry	2-D Geometry

Course Timeline: Mathematics 9

MONTH	SEPTEMBER		OCTOBER	NOVEMBER	DECEMBER	JANUARY		FEBRUARY		MARCH		APRIL		MAY	
Text Unit		1 Square Roots and Surface Area	2 Powers and Exponent Laws	3 Rational Numbers	4 Linear Relations	Vacation		5 Polynomials	6 Linear Equations and Inequalities	7 Similarity and	Vacation	Transformations	8 Circle Geometry	9 Probability and Statistics	
Suggested Timing (weeks)		3	3 – 4	3 – 4	3 – 4			3	3	4			3	2 – 3	

Course Outcomes and Achievement Indicators

Strand: Number	**General Outcome:** Develop number sense.
Specific Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific outcome.*
1. Demonstrate an understanding of powers with integral bases (excluding base 0) and whole number exponents by: • representing repeated multiplication, using powers • using patterns to show that a power with an exponent of zero is equal to one • solving problems involving powers. [C, CN, PS, R]	➢ Demonstrate the differences between the exponent and the base by building models of a given power, such as 2^3 and 3^2. ➢ Explain, using repeated multiplication, the difference between two given powers in which the exponent and base are interchanged; e.g., 10^3 and 3^{10}. ➢ Express a given power as a repeated multiplication. ➢ Express a given repeated multiplication as a power. ➢ Explain the role of parentheses in powers by evaluating a given set of powers; e.g., $(-2)^4$, (-2^4) and -2^4. ➢ Demonstrate, using patterns, that a^0 is equal to 1 for a given value of a ($a \neq 0$). ➢ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
2. Demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole number exponents: • $(a^m)(a^n) = a^{m+n}$ • $a^m \div a^n = a^{m-n}, m > n$ • $(a^m)^n = a^{mn}$ • $(ab)^m = a^m b^m$ • $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0.$ [C, CN, PS, R, T] [ICT: P2–3.4]	➢ Explain, using examples, the exponent laws of powers with integral bases (excluding base 0) and whole number exponents. ➢ Evaluate a given expression by applying the exponent laws. ➢ Determine the sum of two given powers, e.g., $5^2 + 5^3$, and record the process. ➢ Determine the difference of two given powers, e.g., $4^3 - 4^2$, and record the process. ➢ Identify the error(s) in a given simplification of an expression involving powers.
3. Demonstrate an understanding of rational numbers by: • comparing and ordering rational numbers • solving problems that involve arithmetic operations on rational numbers. [C, CN, PS, R, T, V] [ICT: P2–3.4]	➢ Order a given set of rational numbers in fraction and decimal form by placing them on a number line; e.g., $\frac{3}{5}$, −0.666 … , 0.5, $-\frac{5}{8}$, $\frac{3}{2}$. ➢ Identify a rational number that is between two given rational numbers. ➢ Solve a given problem involving operations on rational numbers in fraction or decimal form.
4. Explain and apply the order of operations, including exponents, with and without technology. [PS, T] [ICT: P2–3.4]	➢ Solve a given problem by applying the order of operations without the use of technology. ➢ Solve a given problem by applying the order of operations with the use of technology. ➢ Identify the error in applying the order of operations in a given incorrect solution.
5. Determine the square root of positive rational numbers that are perfect squares. [C, CN, PS, R, T] [ICT: P2–3.4]	(Students should be aware of the existence of positive and negative square roots; however, at this grade, they should only work with the principal, positive square root.) ➢ Determine whether or not a given rational number is a square number, and explain the reasoning. ➢ Determine the square root of a given positive rational number that is a perfect square. ➢ Identify the error made in a given calculation of a square root; e.g., is 3.2 the square root of 6.4? ➢ Determine a positive rational number, given the square root of that positive rational number.
6. Determine an approximate square root of positive rational numbers that are non-perfect squares. [C, CN, PS, R, T] [ICT: P2–3.4]	➢ Estimate the square root of a given rational number that is not a perfect square, using the roots of perfect squares as benchmarks. ➢ Determine an approximate square root of a given rational number that is not a perfect square, using technology; e.g., a calculator, a computer. ➢ Explain why the square root of a given rational number as shown on a calculator may be an approximation. ➢ Identify a number with a square root that is between two given numbers.

Strand: Patterns and Relations (Patterns)	**General Outcome:** Use patterns to describe the world and to solve problems.
Specific Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
1. Generalize a pattern arising from a problem-solving context, using a linear equation, and verify by substitution. [C, CN, PS, R, V]	➢ Write an expression representing a given pictorial, oral or written pattern. ➢ Write a linear equation to represent a given context. ➢ Describe a context for a given linear equation. ➢ Solve, using a linear equation, a given problem that involves pictorial, oral and written linear patterns. ➢ Write a linear equation representing the pattern in a given table of values, and verify the equation by substituting values from the table.
2. Graph a linear relation, analyze the graph, and interpolate or extrapolate to solve problems. [C, CN, PS, R, T, V] [ICT: C7–3.1, P2–3.3]	➢ Describe the pattern found in a given graph. ➢ Graph a given linear relation, including horizontal and vertical lines. ➢ Match given equations of linear relations with their corresponding graphs. ➢ Extend a given graph (extrapolate) to determine the value of an unknown element. ➢ Interpolate the approximate value of one variable on a given graph, given the value of the other variable. ➢ Extrapolate the approximate value of one variable from a given graph, given the value of the other variable. ➢ Solve a given problem by graphing a linear relation and analyzing the graph.

Strand: Patterns and Relations (Variables and Equations)	**General Outcome:** Represent algebraic expressions in multiple ways.
Specific Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
3. Model and solve problems, using linear equations of the form: • $ax = b$ • $\frac{x}{a} = b$, $a \neq 0$ • $ax + b = c$ • $\frac{x}{a} + b = c$, $a \neq 0$ • $ax = b + cx$ • $a(x + b) = c$ • $ax + b = cx + d$ • $a(bx + c) = d(ex + f)$ • $\frac{a}{x} = b$, $x \neq 0$ where a, b, c, d, e and f are rational numbers. [C, CN, PS, V]	➢ Model the solution of a given linear equation, using concrete or pictorial representations, and record the process. ➢ Verify by substitution whether a given rational number is a solution to a given linear equation. ➢ Solve a given linear equation symbolically. ➢ Identify and correct an error in a given incorrect solution of a linear equation. ➢ Represent a given problem, using a linear equation. ➢ Solve a given problem, using a linear equation, and record the process.
4. Explain and illustrate strategies to solve single variable linear inequalities with rational coefficients within a problem-solving context. [C, CN, PS, R, V]	➢ Translate a given problem into a single variable linear inequality, using the symbols ≥, >, < or ≤. ➢ Determine if a given rational number is a possible solution of a given linear inequality. ➢ Generalize and apply a rule for adding or subtracting a positive or negative number to determine the solution of a given inequality. ➢ Generalize and apply a rule for multiplying or dividing by a positive or negative number to determine the solution of a given inequality. ➢ Solve a given linear inequality algebraically, and explain the process orally or in written form. ➢ Compare and explain the process for solving a given linear equation to the process for solving a given linear inequality. ➢ Graph the solution of a given linear inequality on a number line. ➢ Compare and explain the solution of a given linear equation to the solution of a given linear inequality. ➢ Verify the solution of a given linear inequality, using substitution for multiple elements in the solution. ➢ Solve a given problem involving a single variable linear inequality, and graph the solution.

Strand: Patterns and Relations (Variables and Equations) (continued)	**General Outcome:** Represent algebraic expressions in multiple ways.
5. Demonstrate an understanding of polynomials (limited to polynomials of degree less than or equal to 2). [C, CN, R, V]	➢ Create a concrete model or a pictorial representation for a given polynomial expression. ➢ Write the expression for a given model of a polynomial. ➢ Identify the variables, degree, number of terms and coefficients, including the constant term, of a given simplified polynomial expression. ➢ Describe a situation for a given first degree polynomial expression. ➢ Match equivalent polynomial expressions given in simplified form; e.g., $4x - 3x^2 + 2$ is equivalent to $-3x^2 + 4x + 2$.
6. Model, record and explain the operations of addition and subtraction of polynomial expressions, concretely, pictorially and symbolically (limited to polynomials of degree less than or equal to 2). [C, CN, PS, R, V]	➢ Model addition of two given polynomial expressions concretely or pictorially, and record the process symbolically. ➢ Model subtraction of two given polynomial expressions concretely or pictorially, and record the process symbolically. ➢ Identify like terms in a given polynomial expression. ➢ Apply a personal strategy for addition or subtraction of two given polynomial expressions, and record the process symbolically. ➢ Refine personal strategies to increase their efficiency. ➢ Identify equivalent polynomial expressions from a given set of polynomial expressions, including pictorial and symbolic representations. ➢ Identify the error(s) in a given simplification of a given polynomial expression.
7. Model, record and explain the operations of multiplication and division of polynomial expressions (limited to polynomials of degree less than or equal to 2) by monomials, concretely, pictorially and symbolically. [C, CN, R, V]	➢ Model multiplication of a given polynomial expression by a given monomial concretely or pictorially, and record the process symbolically. ➢ Model division of a given polynomial expression by a given monomial concretely or pictorially, and record the process symbolically. ➢ Apply a personal strategy for multiplication and division of a given polynomial expression by a given monomial. ➢ Refine personal strategies to increase their efficiency. ➢ Provide examples of equivalent polynomial expressions. ➢ Identify the error(s) in a given simplification of a given polynomial expression.

Strand: Shape and Space (Measurement)	**General Outcome:** Use direct and indirect measurement to solve problems.
Specific Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
1. Solve problems and justify the solution strategy, using the following circle properties: • the perpendicular from the centre of a circle to a chord bisects the chord • the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc • the inscribed angles subtended by the same arc are congruent • a tangent to a circle is perpendicular to the radius at the point of tangency. [C, CN, PS, R, T, V] [ICT: C6–3.1, C6–3.4]	➢ Provide an example that illustrates: • the perpendicular from the centre of a circle to a chord bisects the chord • the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc • the inscribed angles subtended by the same arc are congruent • a tangent to a circle is perpendicular to the radius at the point of tangency. ➢ Solve a given problem involving application of one or more of the circle properties. ➢ Determine the measure of a given angle inscribed in a semicircle, using the circle properties. ➢ Explain the relationship among the centre of a circle, a chord and the perpendicular bisector of the chord.

Strand: Shape and Space (3-D Objects and 2-D Shapes)	**General Outcome:** Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.
Specific Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
2. Determine the surface area of composite 3-D objects to solve problems. [C, CN, PS, R, V]	➢ Determine the area of overlap in a given composite 3-D object, and explain the effect on determining the surface area (limited to right cylinders, right rectangular prisms and right triangular prisms). ➢ Determine the surface area of a given composite 3-D object (limited to right cylinders, right rectangular prisms and right triangular prisms). ➢ Solve a given problem involving surface area.
3. Demonstrate an understanding of similarity of polygons. [C, CN, PS, R, V]	➢ Determine if the polygons in a given pre-sorted set are similar, and explain the reasoning. ➢ Draw a polygon similar to a given polygon, and explain why the two are similar. ➢ Solve a given problem, using the properties of similar polygons.

Strand: Shape and Space (Transformations)	**General Outcome:** Describe and analyze position and motion of objects and shapes.
Specific Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
4. Draw and interpret scale diagrams of 2-D shapes. [CN, R, T, V] [ICT: C6–3.4]	➢ Identify an example of a scale diagram in print and electronic media, e.g., newspapers, the Internet, and interpret the scale factor. ➢ Draw a diagram to scale that represents an enlargement or a reduction of a given 2-D shape. ➢ Determine the scale factor for a given diagram drawn to scale. ➢ Determine if a given diagram is proportional to the original 2-D shape, and, if it is, state the scale factor. ➢ Solve a given problem that involves the properties of similar triangles.
5. Demonstrate an understanding of line and rotation symmetry. [C, CN, PS, V]	➢ Classify a given set of 2-D shapes or designs according to the number of lines of symmetry. ➢ Complete a 2-D shape or design, given one half of the shape or design and a line of symmetry. ➢ Determine if a given 2-D shape or design has rotation symmetry about the point at its centre, and, if it does, state the order and angle of rotation. ➢ Rotate a given 2-D shape about a vertex, and draw the resulting image. ➢ Identify a line of symmetry or the order and angle of rotation symmetry in a given tessellation. ➢ Identify the type of symmetry that arises from a given transformation on a Cartesian plane. ➢ Complete, concretely or pictorially, a given transformation of a 2-D shape on a Cartesian plane; record the coordinates; and describe the type of symmetry that results. ➢ Identify and describe the types of symmetry created in a given piece of artwork. ➢ Determine whether or not two given 2-D shapes on a Cartesian plane are related by either rotation or line symmetry. ➢ Draw, on a Cartesian plane, the translation image of a given shape, using a given translation rule such as R2, U3 or → →, ↑↑↑; label each vertex and its corresponding ordered pair; and describe why the translation does not result in line or rotation symmetry. ➢ Create or provide a piece of artwork that demonstrates line and rotation symmetry, and identify the line(s) of symmetry and the order and angle of rotation.

Strand: Statistics and Probability (Data Analysis)	**General Outcome:** Collect, display and analyze data to solve problems.
Specific Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
1. Describe the effect of: • bias • use of language • ethics • cost • time and timing • privacy • cultural sensitivity on the collection of data. [C, CN, R, T] [ICT: F4–3.2, F4–3.3]	➢ Analyze a given case study of data collection; and identify potential problems related to bias, use of language, ethics, cost, time and timing, privacy or cultural sensitivity. ➢ Provide examples to illustrate how bias, use of language, ethics, cost, time and timing, privacy or cultural sensitivity may influence data.
2. Select and defend the choice of using either a population or a sample of a population to answer a question. [C, CN, PS, R]	➢ Identify whether a given situation represents the use of a sample or a population. ➢ Provide an example of a situation in which a population may be used to answer a question, and justify the choice. ➢ Provide an example of a question where a limitation precludes the use of a population; and describe the limitation, e.g., too costly, not enough time, limited resources. ➢ Identify and critique a given example in which a generalization from a sample of a population may or may not be valid for the population. ➢ Provide an example to demonstrate the significance of sample size in interpreting data.
3. Develop and implement a project plan for the collection, display and analysis of data by: • formulating a question for investigation • choosing a data collection method that includes social considerations • selecting a population or a sample • collecting the data • displaying the collected data in an appropriate manner • drawing conclusions to answer the question. [C, PS, R, T, V] [ICT: C1–3.5, C4–3.1, C6–3.1, C6–3.2, C7–3.1, C7–3.2, P1–3.4, P2–3.1]	➢ Create a rubric to assess a project that includes the assessment of: • a question for investigation • the choice of a data collection method that includes social considerations • the selection of a population or a sample and the justification for the selection • the display of collected data • the conclusions to answer the question. ➢ Develop a project plan that describes: • a question for investigation • the method of data collection that includes social considerations • the method for selecting a population or a sample • the methods for display and analysis of data. ➢ Complete the project according to the plan, draw conclusions, and communicate findings to an audience. ➢ Self-assess the completed project by applying the rubric.

Strand: Statistics and Probability (Chance and Uncertainty)	**General Outcome:** Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.
Specific Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators may be used to determine whether students have met the corresponding specific outcome.*
4. Demonstrate an understanding of the role of probability in society. [C, CN, R, T] [ICT: F4–3.3]	➢ Provide an example from print and electronic media, e.g., newspapers, the Internet, where probability is used. ➢ Identify the assumptions associated with a given probability, and explain the limitations of each assumption. ➢ Explain how a single probability can be used to support opposing positions. ➢ Explain, using examples, how decisions may be based on a combination of theoretical probability, experimental probability and subjective judgement.