

Mathletics Ontario Program of Studies Understanding Practice and Fluency (UPF)



Grades 9

November, 2021

Mathletics

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Ontario Program of Studies

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Grade 9	3
1 Number.....	3
1.1 Development of numbers and number sets: demonstrate an understanding of the development and use of numbers, and make connections between sets of numbers.....	3
1.2 Powers: represent numbers in various ways, evaluate powers, and simplify expressions by using the relationships between powers and their exponents	3
1.3 Number sense and operations: apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems.....	4
2 Algebra.....	6
2.1 Algebraic expressions and equations: demonstrate an understanding of the development and use of algebraic concepts and of their connection to numbers, using various tools and representations	6
2.2 Coding: apply coding skills to represent mathematical concepts and relationships dynamically, and to solve problems, in algebra and across the other strand	7
2.3 Application of relations: represent and compare linear and non-linear relations that model real-life situations, and use these representations to make predictions.....	7
2.4 Characteristics of relations: demonstrate an understanding of the characteristics of various representations of linear and non-linear relations, using tools, including coding when appropriate	8
3 Data	9
3.1 Collection, representation, and analysis of data: describe the collection and use of data, and represent and analyse data involving one and two variables	9
3.2 Mathematical modelling: apply the process of mathematical modelling, using data and mathematical concepts from other strands, to represent, analyse, make predictions, and provide insight into real-life situations.....	9
4 Geometry and Measurement	11
4.1 Geometric and measurement relationships: demonstrate an understanding of the development and use of geometric and measurement relationships, and apply these relationships to solve problems, including problems involving real-life situations	11
5 Financial Literacy.....	13
5.1 Financial decisions: demonstrate the knowledge and skills needed to make informed financial decisions	13

Grade 9

1 Number

1.1 Development of numbers and number sets: demonstrate an understanding of the development and use of numbers, and make connections between sets of numbers

Outcome	Quests	Content
1. Development and use of numbers: research a number concept to tell a story about its development and use in a specific culture, and describe its relevance in a current context	Teacher directed	Teacher directed
2. Number sets: describe how various subsets of a number system are defined, and describe similarities and differences between these subsets	Real numbers	Distinguishing between different sets of numbers
3. Number sets: use patterns and number relationships to explain density, infinity, and limit as they relate to number sets	Infinite nature of sets of real numbers	Understanding the infinite nature of number sets
	Pattern & number relationships	Finding the nth term of a linear sequence
		Recognizing geometric sequences & common ratios

1.2 Powers: represent numbers in various ways, evaluate powers, and simplify expressions by using the relationships between powers and their exponents

Outcome	Quests	Content
1. Powers: analyse, through the use of patterning, the relationship between the sign and size of an exponent and the value of a power, and use this relationship to express numbers in scientific notation and evaluate powers	Investigate exponent notation	Investigating exponent notation
	Scientific notation	Writing numbers in scientific notation
		Scientific notation: small numbers
		Scientific notation: large numbers
2. Powers: analyse, through the use of patterning, the relationships between the exponents of powers and the operations with powers,	Exponent laws	Applying exponent laws with negative exponents
		Applying exponent laws for multiplication

and use these relationships to simplify numeric and algebraic expressions	Applying exponent laws for division
	Applying exponent laws for power of a power
	Applying the zero exponent law
	Applying mixed exponent laws
	Exponent laws for multiplication: algebraic bases
	Exponent laws for division: algebraic bases
	Exponent laws, power of a power: algebraic bases
	Simplifying expressions with negative powers
	Exponent laws for zero exponent: algebraic bases
	Mixed exponent laws: algebraic bases
	Numerical expressions: negative exponents

1.3 Number sense and operations: apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems

Outcome	Quests	Content
1. Rational numbers: apply an understanding of integers to describe location, direction, amount, and changes in any of these, in various contexts	Integers	Investigating & interpreting integers
	Opposites on the number line	Opposites on the number line
	Graph in the 4 quadrants	Graphing coordinates in the 4 quadrants
		Graphing coordinates across the x-axis & y-axis
	Graph rational numbers	Placing rational numbers on the number line
		Graphing rational numbers on the coordinate plane
	Order rational numbers	Exploring the everyday language of integers
		Statements of order: rational numbers
		Interpreting meanings of integers in context

2. Rational numbers: apply an understanding of unit fractions and their relationship to other fractional amounts, in various contexts, including the use of measuring tools	Calculate unit rates	Calculating unit rates
3. Rational numbers: apply an understanding of integers to explain the effects that positive and negative signs have on the values of ratios, rates, fractions, and decimals, in various contexts	Compare & order integers	Comparing & ordering integers
4. Applications: solve problems involving operations with positive and negative fractions and mixed numbers, including problems involving formulas, measurements, and linear relations, using technology when appropriate	Positive & negative fractions	Adding & subtracting signed fractions
		Multiplying & dividing signed fractions
5. Applications: pose and solve problems involving rates, percentages, and proportions in various contexts, including contexts connected to real-life applications of data, measurement, geometry, linear relations, and financial literacy	Pose & solve real-life problems	Solving real-life percentage problems
		Solving real-life ratio problems
		Real-life ratio & proportions problems, bar models

2 Algebra

2.1 Algebraic expressions and equations: demonstrate an understanding of the development and use of algebraic concepts and of their connection to numbers, using various tools and representations

Outcome	Quests	Content
1. Development and use of algebra: research an algebraic concept to tell a story about its development and use in a specific culture, and describe its relevance in a current context	Teacher directed	Teacher directed
2. Algebraic expressions and equations: create algebraic expressions to generalize relationships expressed in words, numbers, and visual representations, in various contexts	Write algebraic expressions	Writing algebraic expressions
3. Algebraic expressions and equations: compare algebraic expressions using concrete, numerical, graphical, and algebraic methods to identify those that are equivalent, and justify their choices	Equivalent expressions	Verifying equivalent expressions: linear sequences
		Equivalent algebraic expressions
4. Algebraic expressions and equations: simplify algebraic expressions by applying properties of operations of numbers, using various representations and tools, in different contexts	Apply properties to simplify expressions	Applying properties to simplify expressions
5. Algebraic expressions and equations: create and solve equations for various contexts, and verify their solutions	Create & solve equations	Translating & solving word problems
		2-step linear equations, integer solutions
		2-step linear equations, non-integer solutions
		3-step linear equations
		Linear equations with variables on both sides
Linear equations with grouping symbols		

2.2 Coding: apply coding skills to represent mathematical concepts and relationships dynamically, and to solve problems, in algebra and across the other strand

Outcome	Quests	Content
1. Coding: use coding to demonstrate an understanding of algebraic concepts including variables, parameters, equations, and inequalities	Teacher directed	Teacher directed
2. Coding: create code by decomposing situations into computational steps in order to represent mathematical concepts and relationships, and to solve problems	Teacher directed	Teacher directed
3. Coding: read code to predict its outcome, and alter code to adjust constraints, parameters, and outcomes to represent a similar or new mathematical situation	Teacher directed	Teacher directed

2.3 Application of relations: represent and compare linear and non-linear relations that model real-life situations, and use these representations to make predictions

Outcome	Quests	Content
1. Application of linear and non-linear relations: compare the shapes of graphs of linear and non-linear relations to describe their rates of change, to make connections to growing and shrinking patterns, and to make predictions	Graphs of linear & non-linear relations	Exploring graphs of non-linear relationships
		Graphs of linear & non-linear relationships
2. Application of linear and non-linear relations: represent linear relations using concrete materials, tables of values, graphs, and equations, and make connections between the various representations to demonstrate an understanding of rates of change and initial values	Linear relations	Graphing a linear relation by making a table
		Equations in the form $y = ax + b$
		Determining rate of change & initial value

3. Application of linear and non-linear relations: compare two linear relations of the form $y = ax + b$ graphically and algebraically, and interpret the meaning of their point of intersection in terms of a given context	Simultaneous equations	Understanding simultaneous equations
		Solving simultaneous equations graphically
		Solving simultaneous equations algebraically
		Checking answers to simultaneous equations

2.4 Characteristics of relations: demonstrate an understanding of the characteristics of various representations of linear and non-linear relations, using tools, including coding when appropriate

Outcome	Quests	Content
1. Characteristics of linear and non-linear relations: compare characteristics of graphs, tables of values, and equations of linear and non-linear relations	Compare linear relationships	Comparing linear relationships, Cartesian plane
2. Characteristics of Linear and Non-Linear Relations: graph relations represented as algebraic equations of the forms $x = k$, $y = k$, $x + y = k$, $x - y = k$, $ax + by = k$, and $xy = k$, and their associated inequalities, where a , b , and k are constants, to identify various characteristics and the points and/or regions defined by these equations and inequalities	Graph horizontal & vertical lines	Graphing horizontal & vertical lines
3. Characteristics of linear and non-linear relations: translate, reflect, and rotate lines defined by $y = ax$, where a is a constant, and describe how each transformation affects the graphs and equations of the defined lines	Teacher directed	Teacher directed
4. Characteristics of linear and non-linear relations: determine the equations of lines from graphs, tables of values, and concrete representations of linear relations by making connections between rates of change and slopes, and between initial values and y -intercepts, and use these equations to solve problems	Model real-life relationships	Modelling real-life relationships: constant rates
		Determining the equation from a graph

3 Data

3.1 Collection, representation, and analysis of data: describe the collection and use of data, and represent and analyse data involving one and two variables

Outcome	Quests	Content
1. Application of data: identify a current context involving a large amount of data, and describe potential implications and consequences of its collection, storage, representation, and use	Teacher directed	Teacher directed
2. Representation and analysis of data: represent and statistically analyse data from a real-life situation involving a single variable in various ways, including the use of quartile values and box plots	Box plots	Constructing box plots Analysing box plots
	Define quartiles & interquartile range	Defining quartiles & interquartile range
3. Representation and analysis of data: create a scatter plot to represent the relationship between two variables, determine the correlation between these variables by testing different regression models using technology, and use a model to make predictions when appropriate	Scatter plots	Constructing scatter plots Analysing scatter plots

3.2 Mathematical modelling: apply the process of mathematical modelling, using data and mathematical concepts from other strands, to represent, analyse, make predictions, and provide insight into real-life situations

Outcome	Quests	Content
1. Application of mathematical modelling: describe the value of mathematical modelling and how it is used in real life to inform decisions	Teacher directed	Teacher directed
2. Process of mathematical modelling: identify a question of interest requiring the collection and analysis of data, and identify the information needed to answer the question	Teacher directed	Teacher directed

<p>3. Process of mathematical modelling: create a plan to collect the necessary data on the question of interest from an appropriate source, identify assumptions, identify what may vary and what may remain the same in the situation, and then carry out the plan</p>	<p>Construct & conduct a survey</p>	<p>Constructing & conducting a survey</p>
<p>4. Process of mathematical modelling: determine ways to display and analyse the data in order to create a mathematical model to answer the original question of interest, taking into account the nature of the data, the context, and the assumptions made</p>	<p>Teacher directed</p>	<p>Teacher directed</p>
<p>5. Process of mathematical modelling: report how the model can be used to answer the question of interest, how well the model fits the context, potential limitations of the model, and what predictions can be made based on the model</p>	<p>Teacher directed</p>	<p>Teacher directed</p>

4 Geometry and Measurement

4.1 Geometric and measurement relationships: demonstrate an understanding of the development and use of geometric and measurement relationships, and apply these relationships to solve problems, including problems involving real-life situations

Outcome	Quests	Content
1. Geometric and measurement relationships: research a geometric concept or a measurement system to tell a story about its development and use in a specific culture or community, and describe its relevance in connection to careers and to other disciplines	Teacher directed	Teacher directed
2. Geometric and measurement relationships: create and analyse designs involving geometric relationships and circle and triangle properties, using various tools	Tessellations	Investigating tessellations using transformations
3. Geometric and measurement relationships: solve problems involving different units within a measurement system and between measurement systems, including those from various cultures or communities, using various representations and technology, when appropriate	Unit conversions	Converting between metric & imperial units: length Converting between metric & imperial units: mass
	Solve problems using scale drawings	Solving problems using scale drawings
4. Geometric and measurement relationships: show how changing one or more dimensions of a two-dimensional shape and a three-dimensional object affects perimeter/circumference, area, surface area, and volume, using technology when appropriate	Teacher directed	Teacher directed
5. Geometric and measurement Relationships: solve problems involving the side-length relationship for right triangles in real-life situations, including problems that involve composite shapes	Real-life problems, Pythagorean Theorem	Pythagorean Theorem: bearings
		Solving real-life problems, Pythagorean Theorem

6. Geometric and measurement relationships: solve problems using the relationships between the volume of prisms and pyramids and between the volume of cylinders and cones, involving various units of measure	Volume of pyramids & prisms	Finding the volume of pyramids
		Finding the volume of any prisms
		Finding the volume of composite/irregular prisms
		Finding the volume of rectangular prisms
		Finding the height of prisms
		Finding missing dimensions of rectangular prisms
		Finding the volume of triangular prisms
		Finding the missing dimension of triangular prisms
	Volume of cylinders & cones	Developing the formula for the volume of cylinders
		Finding the volume of cones

5 Financial Literacy

5.1 Financial decisions: demonstrate the knowledge and skills needed to make informed financial decisions

Outcome	Quests	Content
1. Financial decisions: identify a past or current financial situation and explain how it can inform financial decisions, by applying an understanding of the context of the situation and related mathematical knowledge	Teacher directed	Teacher directed
2. Financial decisions: identify financial situations that involve appreciation and depreciation, and use associated graphs to answer related questions	Appreciation & depreciation	Understanding appreciation & depreciation
3. Financial decisions: compare the effects that different interest rates, lengths of borrowing time, ways in which interest is calculated, and amounts of down payments have on the overall costs associated with purchasing goods or services, using appropriate tools	Calculate interest	Calculating simple interest
		Calculating compound interest
		Comparing simple & compound interest
4. Financial decisions: modify budgets displayed in various ways to reflect specific changes in circumstances, and provide a rationale for the modifications	Teacher directed	Teacher directed



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