

Progression of Learning Secondary-Mathematics

Arithmetic

Understanding real numbers						
→ Student constructs knowledge with teacher guidance. ★ Student applies knowledge by the end of the school year. Student reinvests knowledge. ¹	Elementary	Secondary				
		Cycle One	Cycle Two			
	6	1	2	3	4	5
1. Natural numbers less than 1 000 000						
a. Reads and writes any natural number	★					
b. Represents natural numbers in different ways	★					
c. Composes and decomposes a natural number in a variety of ways and identifies equivalent expressions	★					
d. Approximates a natural number	★					
e. Compares natural numbers or arranges natural numbers in increasing or decreasing order	★					
f. Classifies natural numbers in various ways, based on their properties (e.g. even numbers, composite numbers)	★					
Gizmos: Finding Factors with Area Models						
2. Fractions						
a. Represents a fraction in a variety of ways (using objects or drawings)	★					
Gizmos: Fraction Garden (Comparing Fractions) Toy Factory (Set Models of Fractions)						
b. Identifies the different meanings of fractions: part of a whole, division, ratio, operator, measurement	→	→	★			

<p>Gizmos:</p> <p>Adding Fractions (Fraction Tiles)</p> <p>Beam to Moon (Ratios and Proportions)</p> <p>Fractions Greater than One (Fraction Tiles)</p> <p>Part-to-part and Part-to-whole Ratios</p> <p>Polling: Neighborhood</p> <p>Proportions and Common Multipliers</p> <p>Toy Factory (Set Models of Fractions)</p>						
<p>c. Verifies whether two fractions are equivalent</p> <p>Gizmos:</p> <p>Fraction Garden (Comparing Fractions)</p>	★					
<p>d. Compares a fraction to 0, $\frac{1}{2}$ or 1</p> <p>Gizmos:</p> <p>Adding Fractions (Fraction Tiles)</p> <p>Comparing and Ordering Fractions</p> <p>Fraction Garden (Comparing Fractions)</p> <p>Fractions Greater than One (Fraction Tiles)</p> <p>Ordering Percents, Fractions and Decimals</p> <p>Ordering Percents, Fractions, and Decimals Greater Than 1</p>						
<p>e. Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numerator</p> <p>Gizmos:</p> <p>Comparing and Ordering Fractions</p> <p>Fraction Garden (Comparing Fractions)</p> <p>Ordering Percents, Fractions and Decimals</p> <p>Ordering Percents, Fractions, and Decimals Greater Than 1</p>						
<p>3. Decimals up to thousandths</p>						
<p>a. Represents decimals in a variety of ways (using objects or drawings) and identifies equivalent representations</p> <p>Gizmos:</p> <p>Improper Fractions and Mixed Numbers</p> <p>Ordering Percents, Fractions and Decimals</p>	★					

Ordering Percents, Fractions, and Decimals Greater Than 1 Percents, Fractions, and Decimals						
b. Reads and writes numbers written in decimal notation Gizmos: Comparing and Ordering Decimals	★					
c. Approximates a number written in decimal notation	★					
d. Composes and decomposes a number written in decimal notation and recognizes equivalent expressions Gizmos: Ordering Percents, Fractions and Decimals Ordering Percents, Fractions, and Decimals Greater Than 1 Percents, Fractions, and Decimals	★					
e. Compares numbers written in decimal notation or arranges them in increasing or decreasing order Gizmos: Comparing and Ordering Decimals Ordering Percents, Fractions and Decimals Ordering Percents, Fractions, and Decimals Greater Than 1	★					
4. Integers						
a. Represents integers in a variety of ways (using objects or drawings)	★					
b. Reads and writes integers	★					
c. Compares integers or arranges integers in increasing or decreasing order Gizmos: Integers, Opposites, and Absolute Values	★					

<p>5. Expresses numbers in a variety of ways (fractional, decimal percentage notation)</p> <p>Gizmos:</p> <p>Improper Fractions and Mixed Numbers</p> <p>Ordering Percents, Fractions and Decimals</p> <p>Ordering Percents, Fractions, and Decimals Greater Than 1</p> <p>Percents and Proportions</p> <p>Percents, Fractions, and Decimals</p>		★			
<p>6. Represents, reads and writes numbers written in fractional or decimal notation</p> <p>Gizmos:</p> <p>Fraction Garden (Comparing Fractions)</p> <p>Toy Factory (Set Models of Fractions)</p>		★			
<p>7. Approximates, in various contexts, the numbers under study (e.g. estimates, rounds off, truncates)</p>		★			
<p>8. Distinguishes rational numbers from irrational numbers in the set of real numbers</p> <p>Note : Although students do not systematically study sets of numbers in Secondary Cycle One, they should still be encouraged to use the proper terms learned in elementary school (natural numbers, integers, decimals).</p>			★		
<p>9. Represents, in different types of notation, various subsets of real numbers (discrete or continuous): interval, list/roster, on a number line</p> <p>Note : In TS and S, set builder notation may be introduced as needed.</p>			★		
<p>10. Defines the concept absolute value in context (e.g. difference between two numbers, distance between two points)</p> <p>Note : In Cycle One and Secondary III, the concept of <i>absolute value</i> is introduced informally, using examples</p> <p>Gizmos:</p> <p>Comparing and Ordering Decimals</p> <p>Comparing and Ordering Fractions</p> <p>Integers, Opposites, and Absolute Values</p>		→	→	→	★

11. Represents and writes						
a. the power of a natural number	★					
b. squares and square roots Gizmos: Square Roots		→	★			
c. numbers in exponential notation (integral exponent) Gizmos: Dividing Exponential Expressions Exponents and Power Rules		→	★			
d. numbers in scientific notation				★		
e. cubes and cube roots				★		
f. numbers in exponential notation (fractional exponents)				★		
g. numbers using radicals or rational exponents						CST
				★		TS
				★		S
a. numbers in logarithmic notation using the equivalence $\log_a x = n \iff a^n = x$, if necessary						CST
				→	★	TS
				★		S
12. Estimates the value of the power of an exponential expression with respect to its components: base (between 0 and 1, greater than 1), exponent (positive or negative, integral or fractional) Note : The same applies for a logarithmic expression in TS and S.				★		CST
				→	★	TS
				★		S
13. Estimates the order of magnitude of a real number in different contexts	→	→	→	★		
14. Estimates the order of magnitude of a real number using scientific notation				★		
15. Compares and arranges in order						
a. numbers written in fractional or decimal notation Gizmos: Comparing and Ordering Decimals	★					

Comparing and Ordering Fractions Fraction Garden (Comparing Fractions) Ordering Percents, Fractions and Decimals Ordering Percents, Fractions, and Decimals Greater Than 1								
<p>b. numbers expressed in different ways (fractional, decimal, exponential [integral exponent], percentage, square root, scientific notation)</p> <p>b.i. Note : Scientific notation is introduced in Secondary III.</p> <p>Gizmos:</p> Fraction Garden (Comparing Fractions) Percents and Proportions Square Roots Unit Conversions								

Understanding operations involving real numbers								
→	★	Student constructs knowledge with teacher guidance.	Elementary	Secondary				
				Cycle One	Cycle Two			
		Student applies knowledge by the end of the school year.						
		Student reinvests knowledge.						
			6	1	2	3	4	5
1. Natural numbers less than 1 000 000								
		a. Determines the operation(s) to perform in a given situation						
		Gizmos:						
		Adding on the Number Line						
		b. Uses objects, diagrams or equations to represent a situation and, conversely, describes a situation represented by objects, diagrams or equations (use of different meanings of the four operations)						
		c. Establishes equality relations between numerical expressions (e.g. $3 + 2 = 6 - 1$)						

<p>d. Determines numerical equivalencies using relationships between operations, the commutative and associative properties of addition and multiplication, the distributive property of multiplication over addition or subtraction</p> <p>Gizmos: Chocomatic (Multiplication, Arrays, and Area)</p>	★					
<p>e. Translates a situation using a sequence of operations in accordance with the order of operations</p> <p>Gizmos: Order of Operations</p>	★					
2. Fractions						
<p>a. Uses objects, diagrams or an operation to represent a situation and, conversely, describes a situation represented by objects, diagrams or an operation (use of different meanings of addition, subtraction and multiplication by a natural number)</p>	★					
<p>b. Uses an operation to represent a situation (use of different meanings of operations)</p>	→★					
3. Decimals						
<p>a. Uses objects, diagrams or equations to represent a situation and, conversely, describes a situation represented by objects, diagrams or equations (use of different meanings of the four operations)</p>	★					
<p>b. Determines numerical equivalencies using relationships between operations (inverse operations), the commutative and associative properties of addition and multiplication, the distributive property of multiplication over addition or subtraction</p> <p>Gizmos: Chocomatic (Multiplication, Arrays, and Area)</p>	★					
<p>c. Translates a situation using a sequence of operations in accordance with the order of operations</p>	★					

<p>Gizmos: Order of Operations</p>					
<p>4. Chooses an appropriate way of writing numbers for a given context Note : Over the years, new notation systems such as scientific notation are added to the students' repertoire.</p> <p>Gizmos: Ordering Percents, Fractions and Decimals Ordering Percents, Fractions, and Decimals Greater Than 1 Percents, Fractions, and Decimals</p>	★				
<p>5. Looks for equivalent expressions: decomposing (additive, multiplicative, etc.), equivalent fractions, simplifying and reducing, factoring, etc.</p> <p>Gizmos: Finding Factors with Area Models Fraction Garden (Comparing Fractions) Toy Factory (Set Models of Fractions)</p>	★				
<p>6. Translates (mathematizes) a situation using a sequence of operations (no more than two levels of parentheses)</p> <p>Gizmos: Order of Operations</p>	★				
<p>7. Anticipates the results of operations</p> <p>Gizmos: Chocomatic (Multiplication, Arrays, and Area)</p>	★				
<p>8. Interprets the results of operations in light of the context</p> <p>Gizmos: Adding on the Number Line Chocomatic (Multiplication, Arrays, and Area)</p>	★				

Operations involving real numbers						
→ Student constructs knowledge with teacher guidance. ★ Student applies knowledge by the end of the school year. Student reinvests knowledge.	Elementary	Secondary				
		Cycle One		Cycle Two		
	6	1	2	3	4	5
1. Natural numbers less than 1 000 000						
a. Approximates the result of an operation Gizmos: Chocomatic (Multiplication, Arrays, and Area)	★					
b. Using personal processes, mentally computes operations Gizmos: Chocomatic (Multiplication, Arrays, and Area)	★					
c. Determines in writing <ul style="list-style-type: none"> the sum of two natural numbers of up to 4 digits Gizmos: Adding on the Number Line <ul style="list-style-type: none"> the difference between two natural numbers of up to 4 digits whose result is greater than 0 the product of a three-digit number by a two-digit number the quotient of a four-digit number and a two-digit number and expresses the remainder of a division as a decimal that does not go beyond the second decimal place the result of a sequence of operations in accordance with the order of operations Gizmos: Order of Operations	★					
2. Fractions (using objects or diagrams)						
a. Generates a set of equivalent fractions	★					

Gizmos: Fraction Garden (Comparing Fractions)						
b. Reduces a fraction to its simplest form	★					
c. Adds and subtracts fractions when the denominator of one fraction is a multiple of the other fraction	★					
Gizmos: Adding Fractions (Fraction Tiles) Fractions with Unlike Denominators						
d. Multiplies a natural number by a fraction and a fraction by a natural number	★					
3. Decimal numbers up to thousandths						
a. Approximates the result of an operation						
Gizmos: Multiplying with Decimals Sums and Differences with Decimals	★					
b. Mentally computes <ul style="list-style-type: none"> operations (addition, subtraction, multiplication, division by a natural number) 						
Gizmos: Multiplying with Decimals Sums and Differences with Decimals	★					
<ul style="list-style-type: none"> multiplications by 10, 100, 1000 						
Gizmos: Multiplying with Decimals						
c. Computes in writing <ul style="list-style-type: none"> additions and subtractions of numbers whose result does not go beyond the second decimal place 	★					
Gizmos:						

<p>Sums and Differences with Decimals</p> <ul style="list-style-type: none"> • multiplications of numbers whose product does not go beyond the second decimal place <p>Gizmos:</p> <p>Multiplying with Decimals</p> <ul style="list-style-type: none"> • divisions of a decimal by a natural number less than 11 						
4. Properties of divisibility						
<p>a. Determines the divisibility of a number by 2, 3, 4, 5, 6, 8, 9 and 10</p>	★					
<p>b. Uses, in different contexts, the properties of divisibility: 2, 3, 4, 5 and 10</p>	★					
<p>5. Approximates the result of an operation or sequence of operations</p> <p>Gizmos:</p> <p>Chocomatic (Multiplication, Arrays, and Area)</p>	→	★				
<p>6. Mentally computes the four operations, especially with numbers written in decimal notation, using equivalent ways of writing numbers and the properties of operations</p> <p>Gizmos:</p> <p>Adding on the Number Line</p> <p>Chocomatic (Multiplication, Arrays, and Area)</p> <p>Ordering Percents, Fractions and Decimals</p> <p>Ordering Percents, Fractions, and Decimals Greater Than 1</p>	→	★				
7. Computes, in writing, the four operations ¹ with numbers that are easy to work with (including large numbers), using equivalent ways of writing numbers and the properties of operations						
<p>a. numbers written in decimal notation, using rules of signs</p> <p>Gizmos:</p> <p>Multiplying with Decimals</p> <p>Sums and Differences with Decimals</p>	★					
<p>b. positive numbers written in fractional notation,</p>	→	★				

with or without the use of objects or diagrams						
Gizmos: Adding Fractions (Fraction Tiles) Dividing Fractions Dividing Mixed Numbers Fraction Garden (Comparing Fractions) Fractions Greater than One (Fraction Tiles) Fractions with Unlike Denominators Multiplying Fractions Multiplying Mixed Numbers						
c. numbers written in fractional notation			★			
8. Computes, in writing, sequences of operations (numbers written in decimal notation) in accordance with the order of operations, using equivalent ways of writing numbers and the properties of operations (with no more than two levels of parentheses)		★				
Gizmos: Order of Operations						
9. Computes, using a calculator, operations and sequences of operations in accordance with the order of operations		★				
Gizmos: Order of Operations						
10. Switches, as needed, from one way of writing numbers to another: from fractional to percentage notation, from decimal to fractional notation, from decimal to percentage notation, and vice versa		★				
Gizmos: Percents, Fractions, and Decimals						
11. Switches, as needed, from one way of writing numbers to another Note : In Secondary Cycle One, the students should use positive numbers when switching from one type of notation to another. In Secondary Cycle Two, new types of notation are introduced: exponential, scientific notation, etc.		→	★			
12. Calculates the power of a natural number	★					

Gizmos: Dividing Exponential Expressions Exponents and Power Rules									
13. Decomposes a natural number into prime factors Gizmos: Finding Factors with Area Models									*
14. Manipulates numerical expressions involving									
a. integral exponents (rational base) and fractional exponents a.i. Note : When manipulating numerical expressions, students learn to deduce the properties of powers.									*
b. powers of bases (change of base), exponents, radicals (n th root), using their properties b.i. Note : For base changes in TS in Secondary IV, students use bases 2 and 10. In S, students learn to deduce the properties of radicals.									
									CST
									→*
									*
									S
c. logarithms									
a.i. definition and change of base									
									CST
									*
									TS
									*
									S
a.i. properties									
									CST
									*
									TS
									*
									S
d. absolute values									
									CST
									*
									TS
									*
									S

Understanding and analyzing proportional situations
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	Elementary	Secondary				
		Cycle One	Cycle Two			
	6	1	2	3	4	5
→ Student constructs knowledge with teacher guidance. ★ Student applies knowledge by the end of the school year. Student reinvests knowledge.						
1. Calculates						
<p>a. a certain percentage of a number</p> <p>Gizmos: Percent of Change Percents and Proportions Polling: Neighborhood</p>	→★					
<p>b. the value corresponding to 100 per cent</p> <p>Gizmos: Percents and Proportions Polling: Neighborhood</p>	→★					
<p>2. Recognizes ratios and rates</p> <p>Gizmos: Beam to Moon (Ratios and Proportions) Part-to-part and Part-to-whole Ratios Polling: Neighborhood Proportions and Common Multipliers</p>	→★					
<p>3. Interprets ratios and rates</p> <p>Gizmos: Beam to Moon (Ratios and Proportions) Part-to-part and Part-to-whole Ratios Polling: Neighborhood Proportions and Common Multipliers</p>	→★					
<p>4. Describes the effect of changing a term in a ratio or rate</p> <p>Gizmos: Adding on the Number Line Beam to Moon (Ratios and Proportions) Part-to-part and Part-to-whole Ratios Polling: Neighborhood</p>	→★					

Proportions and Common Multipliers						
5. Compares						
<p>a. ratios and rates qualitatively (equivalent rates and ratios, unit rate)</p> <p>Gizmos:</p> <p>Comparing and Ordering Decimals</p> <p>Comparing and Ordering Fractions</p> <p>Fraction Garden (Comparing Fractions)</p> <p>Integers, Opposites, and Absolute Values</p> <p>Road Trip (Problem Solving)</p>		→		★		
<p>b. ratios and rates quantitatively (equivalent rates and ratios, unit rate)</p> <p>Gizmos:</p> <p>Comparing and Ordering Decimals</p> <p>Comparing and Ordering Fractions</p> <p>Fraction Garden (Comparing Fractions)</p> <p>Integers, Opposites, and Absolute Values</p> <p>Road Trip (Problem Solving)</p>		→		★		
<p>6. Translates a situation using a ratio or rate</p> <p>Note : Situations involving ratios and rates are enriched in Secondary Cycle Two (similarity ratio, metric relations, etc.).</p> <p>Gizmos:</p> <p>Part-to-part and Part-to-whole Ratios</p> <p>Polling: Neighborhood</p>		→		★		
<p>7. Recognizes a proportional situation using the context, a table of values or a graph</p> <p>Gizmos:</p> <p>Estimating Population Size</p>		→		★		
<p>8. Represents or interprets a proportional situation using a graph, a table of values or a proportion</p>		→		★		

<p>9. Solves proportional situations (direct or inverse variation) by using different strategies (e.g. unit-rate method, factor of change, proportionality ratio, additive procedure, constant product [inverse variation])</p> <p>Gizmos: Direct and Inverse Variation Part-to-part and Part-to-whole Ratios Polling: Neighborhood Road Trip (Problem Solving)</p>			→ ★			
<p>10. Establishes relationships between first-degree or rational functions and proportional situations (direct or inverse variation)</p>			★			

Algebra

Understanding and manipulating algebraic expressions							
→ Student constructs knowledge with teacher guidance. ★ Student applies knowledge by the end of the school year. Student reinvests knowledge.	Elementary	Secondary					
		Cycle One	Cycle Two				
A. Algebraic expressions	6	1	2	3	4	5	
<p>1. Describes, using his/her own words and mathematical language, numerical patterns</p> <p>Gizmos: Arithmetic and Geometric Sequences</p>							
<p>2. Describes, using his/her own words and mathematical language, series of numbers and family of operations</p> <p>Gizmos: Arithmetic Sequences Arithmetic and Geometric Sequences Arithmetic Sequences Arithmetic and Geometric Sequences</p>	★						
<p>3. Adds new terms to a series when the first three terms or more are given</p> <p>Gizmos:</p>	★						

					★	S
type of notation to another)						CST
a. using formulas for trinomials of the form $ax^2 + bx + c$:					★	TS
$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \quad \text{and} \quad x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$					★	S
a. substituting second-degree algebraic identities (perfect square trinomial and difference of two squares)					★	CST
					★	TS
					★	S
7. Manipulates rational expressions					★	CST
Note : Rational expressions (algebraic fractions) are part of the algebraic expressions to be covered. When finding the common denominator in order to add two rational expressions, students in TS will deal only with cases in which the denominator of one fraction is the multiple of the denominator of the other fraction.					★	TS
					★	S
C. Analyzing situations using equations or inequalities	6	1	2	3	4	5
1. Recognizes whether a situation can be translated by						
a. an equation						
Gizmos: Using Algebraic Equations					→ ★	
b. an inequality					★	
2. Recognizes or constructs						
a. relations or formulas						
Gizmos: Introduction to Functions					→ ★	
b. inequality relations and first-degree inequalities in one variable					★	
3. Manipulates relations or formulas (e.g. isolates an element)						
Gizmos: Introduction to Functions Solving Formulas for any Variable					→ ★	

4. Represents a situation using					
a. a first-degree equation with one unknown					
Gizmos:					
Function Machines 1 (Functions and Tables)					
Function Machines 2 (Functions, Tables, and Graphs)					
Function Machines 3 (Functions and Problem Solving)					
Introduction to Exponential Functions					
b. a first-degree inequality with a variable					
5. Represents					
a. an equation using another register (type) of representation, if necessary					
b. an inequality using another register (type) of representation, if necessary					
6. Determines the missing term in an equation (relations between operations) : ¹					
$a + b = \square, a + \square = c, \square + b = c, a - b = \square, a - \square = c, \square - b = c,$					
$a \times b = \square, a \times \square = c, \square \times b = c, a \div b = \square, a \div \square = c, \square \div b = c$					
Gizmos:					
Modeling and Solving Two-Step Equations					
Solving Equations by Graphing Each Side					
Solving Two-Step Equations					
7. Transforms arithmetic equalities and equations to maintain equivalence (properties and rules for transforming equalities) and justifies the steps followed, if necessary					
Gizmos:					
Chocomatic (Multiplication, Arrays, and Area)					
Modeling and Solving Two-Step Equations					
Solving Equations by Graphing Each Side					
Solving Formulas for any Variable					
Solving Two-Step Equations					
8. Transforms inequalities to maintain equivalence (properties and rules for transforming inequalities) and justifies the steps followed, if necessary					

b. of first-degree equations in two variables b.i. Note : The student chooses the method.					★		
c. composed of a first-degree equation in two variables and a second-degree equation in two variables c.i. Note : In TS, these systems are solved using graphic representations, with or without the use of technological tools.						CST	
					★	TS	
					★	S	
a. of second-degree equations in relation to conics using changing variables, if applicable						CST	
					★	TS	
						S	
a. involving various functional models (mostly graphical solutions)						CST	
					★	TS	
						S	
4. Solves a system							
a. of first-degree inequalities in two variables					★		
b. involving various functional models (mostly graphical solutions)						CST	
					★	TS	
						S	
5. Validates the solution, with or without technological tools				→	★		
6. Interprets the solution or makes decisions if necessary, depending on the context				→	★		
E. Linear programming	6	1	2	3	4	5	
1. Analyzes a situation to be optimized <ul style="list-style-type: none"> ▪ mathematizing the situation using a system of first-degree inequalities in two variables ▪ drawing a bounded or unbounded polygon of constraints to represent the situation ▪ determining the coordinates of the vertices of the bounded polygon (feasible region) Note : In TS, the coordinates of points of intersection may be determined algebraically, using matrices, or approximated based on a graph. <ul style="list-style-type: none"> ▪ recognizing and defining the function to be optimized 						★	
	2. Optimizes a situation by taking into account different constraints and						★

<p>makes decisions with respect to this situation</p> <ul style="list-style-type: none"> ▪ determining the best solution(s) for a particular situation, given a set of possibilities ▪ validating and interpreting the optimal solution, depending on the context ▪ justifying the solution(s) chosen ▪ changing certain conditions associated with the situation to provide a more optimal solution, if necessary 							
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Understanding dependency relationships						
→ Student constructs knowledge with teacher guidance. ★ Student applies knowledge by the end of the school year. Student reinvests knowledge.	Elementary	Secondary				
		Cycle One		Cycle Two		
A. Relations, functions and inverses	6	1	2	3	4	5
1. Identifies patterns in various situations and in various forms Gizmos: Arithmetic and Geometric Sequences Finding Patterns Function Machines 1 (Functions and Tables) Function Machines 2 (Functions, Tables, and Graphs) Function Machines 3 (Functions and Problem Solving) Introduction to Functions Linear Functions Pattern Finder						
2. Analyzes situations using different registers (types) of representation Gizmos: Function Machines 1 (Functions and Tables) Function Machines 2 (Functions, Tables, and Graphs) Function Machines 3 (Functions and Problem Solving) Introduction to Functions Linear Functions		→	→	★		
3. Represents a situation generally using a graph		→	★			

Gizmos: Elevator Operator (Line Graphs) Function Machines 1 (Functions and Tables) Function Machines 2 (Functions, Tables, and Graphs) Function Machines 3 (Functions and Problem Solving) Graphs of Polynomial Functions Introduction to Functions Linear Functions Quadratics in Factored Form Quadratics in Polynomial Form - Activity A Rational Functions								
4. Chooses the dependent variable and the independent variable					*			
5. Recognizes relations, functions and inverses					*			
6. Describes, in the functions under study, the role of								
a. multiplicative parameters					*			CST
					*			TS
					*			S
a. additive parameters								CST
					*			TS
					*			S
7. Performs operations on functions (including composition) Note : In TS, operations on functions can be approached intuitively as of Secondary IV. In Secondary V, they are studied using concrete situations.								CST
					*			TS
					*			S
B. Analyzing situations using real functions¹	6	1	2	3	4	5		
<p>Note : Statements 1 to 9 apply to the functions listed below.</p> <ol style="list-style-type: none"> Models a situation verbally, algebraically, graphically, using a table of values or a scatter plot Finds the rule of a function or its inverse, depending on the context Represents and interprets the inverse Interprets parameters (multiplicative or additive) and describes the effect of changing their value, if necessary Describes the properties of real functions: domain, range, interval within which the function is increasing or decreasing, sign, extrema, x-intercept and y-intercept <p>Note : In Secondary III, students are informally introduced to the study of properties, always in relation to a context. In CST, students use a graphical</p>								

a.i. $f(x) = ac^x$					★	CST
						TS
						S
a.i. $f(x) = ac^{bx}$						CST
a.i.1. Note : In CST, students are able to manipulate this type of function, but are not required to determine the rule.					★	TS
						S
a.i. $f(x) = ac^{b(x-h)} + k$						CST
a.i.1. Note : The study of these functions should focus on bases 2, 10 and e .					★	TS
					★	S
f. Logarithmic functions						
a.i. $f(x) = a \log_c bx$						CST
a.i.1. Note : This function is introduced in connection with exponential functions (as an inverse).					★	TS
						S
a.i. $f(x) = a \log_c b(x-h) + k$						CST
a.i.1. Note : The study of these functions should focus on bases 2, 10 and e .					★	TS
					★	S
g. Piecewise functions						
Note : In Secondary III, students are introduced to this type of function informally.					★	CST
					→★	TS
					★	S
h. Absolute value functions : $f(x) = a b(x-h) + k$						
Note : In TS, this function is treated mainly as a piecewise function.						CST
						TS
					★	S
i. Step functions						
					★	
j. Greatest integer functions						
a.i. $f(x) = a[bx]$						CST
					★	TS
						S
a.i. $f(x) = a[b(x-h)] + k$						CST
					★	TS
					★	S
k. Functions						
					★	CST

a.i. Modelling periodic occurrences (e.g. natural phenomena such as tides or sound, medical or electrical phenomena) a.i.1. Note : The analysis is based on a graphical representation. In this context, students are not required to determine the rule.					★	TS
					★	S
a.i. sinusoidal : $f(x) = a \sin b(x - h) + k$, $f(x) = a \cos b(x - h) + k$						CST
					★	TS
					★	S
a.i. tangent : $f(x) = a \tan b(x - h) + k$						CST
					★	TS
					★	S

Probability

Understanding data from random experiments						
→ Student constructs knowledge with teacher guidance. ★ Student applies knowledge by the end of the school year. Student reinvests knowledge.	Elementary	Secondary				
		Cycle One	Cycle Two			
k.A. Processing data from random experiments	6	1	2	3	4	5
1. Simulates random experiments with or without the use of technological tools Gizmos: Geometric Probability - Activity A Probability Simulations Spin the Big Wheel! (Probability) Theoretical and Experimental Probability	★					
2. Experiments with activities involving chance, using various objects (e.g. spinners, rectangular prisms, glasses, marbles, thumb tacks, 6-, 8- or 12-sided dice) Gizmos: Geometric Probability - Activity A Probability Simulations Spin the Big Wheel! (Probability) Theoretical and Experimental Probability	★					

3. In activities involving chance						
<p>a. recognizes variability in possible outcomes (uncertainty)</p> <p>Gizmos: Spin the Big Wheel! (Probability)</p>	★					
<p>b. recognizes equiprobability (e.g. quantity of objects, symmetry of an object such as a cube)</p> <p>Gizmos: Spin the Big Wheel! (Probability)</p>	★					
<p>c. becomes aware of the independence of events (e.g. rolling dice, tossing a coin, drawing lots)</p> <p>Gizmos: Spin the Big Wheel! (Probability) Independent and Dependent Events</p>	★					
4. Uses tables or diagrams to collect and display the outcomes of an experiment	★					
<p>5. Compares the outcomes of a random experiment with known theoretical probabilities</p> <p>Gizmos: Geometric Probability - Activity A Polling: City Probability Simulations Spin the Big Wheel! (Probability) Theoretical and Experimental Probability</p>	★					
<p>6. Distinguishes between prediction and outcome</p> <p>Gizmos: Geometric Probability - Activity A Probability Simulations Spin the Big Wheel! (Probability) Theoretical and Experimental Probability</p>	★					

1. Represents an event using different registers (types of representation))	★						CST TS S
2. Compares qualitatively the theoretical or experimental probability of an event occurring Gizmos: Probability Simulations Spin the Big Wheel! (Probability) Theoretical and Experimental Probability	★						
3. Distinguishes between theoretical and experimental probability Gizmos: Probability Simulations Spin the Big Wheel! (Probability) Theoretical and Experimental Probability		→	★				
4. Calculates the probability of an event Gizmos: Geometric Probability - Activity A Spin the Big Wheel! (Probability)		→	★				CST TS S
5. Calculates the probability of outcomes of random experiments related to situations involving arrangements, permutations or combinations Note : Calculations are based on reasoning, not on counting formulas. The terminology (permutation, arrangement, combination) may be introduced in the first year of Secondary Cycle Two.					★		CST TS S
6. Associates the type of probability to a situation: experimental, theoretical, subjective						★	CST TS S
7. Calculates probabilities, including geometric probabilities, in measurement contexts				★			CST TS S
8. Calculates conditional probabilities						★	CST TS

							S
9. Interprets probabilities and makes appropriate decisions							CST
Gizmos:							TS
Spin the Big Wheel! (Probability)		→	★				S
10. Chooses and applies the concept of odds/chance (<i>odds for</i> and <i>odds against</i>) or probability, depending on the context						★	CST
						★	TS
							S
11. Determines the <i>odds for</i> or <i>odds against</i>						★	CST
						★	TS
							S
12. Interprets and makes decisions with respect to the odds obtained						★	CST
						★	TS
							S
13. Calculates mathematical expectation						★	CST
						★	TS
							S
14. Modifies, if necessary, the parameters of a situation in order to make it fair, attain an objective or optimize a gain or loss						★	CST
						★	TS
							S
15. Interprets the resulting mathematical expectation and makes appropriate decisions						★	CST
						★	TS
							S

Statistics

Analyzing and making decisions about one- or two-variable distributions, using statistical tools							
→ Student constructs knowledge with teacher guidance.	★ Student applies knowledge by the end of the school year. Student reinvests knowledge.	Elementary	Secondary				
			Cycle One	Cycle Two			
A. One-variable distributions		6	1	2	3	4	5
1. Conducts a survey or a census							
a. Formulates questions for a survey		★					CST
Note : The questions become more refined over the years.							TS
							S

b. Chooses a sampling method :						
a.i. simple random, systematic						
Gizmos: Polling: City Polling: Neighborhood			→	★		
a.ii. stratified, cluster						CST
Gizmos: Polling: Neighborhood				★		TS
						S
c. Chooses a representative sample						
Gizmos: Polling: Neighborhood			→	★		
d. Collects, describes and organizes data (classifies or categorizes) using tables						CST
Gizmos: Movie Reviewer (Mean and Median) Reaction Time 1 (Graphs and Statistics) Reaction Time 2 (Graphs and Statistics)		★				TS
						S
2. Recognizes possible sources of bias						
Note : In CST in Secondary IV, students learn to correct the source of bias, if applicable.			→	★		
3. Interprets data presented in a table or a bar graph, a pictograph, a broken-line graph or a circle graph						
Gizmos: Elevator Operator (Line Graphs) Forest Ecosystem Graphing Skills Prairie Ecosystem Reaction Time 1 (Graphs and Statistics) Reaction Time 2 (Graphs and Statistics)		★				
4. Distinguishes different types of statistical variables: qualitative,			→	★		

discrete or continuous quantitative								
5. Chooses appropriate register(s) (types) of representation to organize, interpret and present data Gizmos: Box-and-Whisker Plots Describing Data Using Statistics Graphing Skills Histograms Movie Reviewer (Mean and Median) Reaction Time 1 (Graphs and Statistics) Reaction Time 2 (Graphs and Statistics) Stem-and-Leaf Plots								
6. Organizes and presents data using								
a. a table, a bar graph, a pictograph and a broken-line graph Gizmos: Describing Data Using Statistics Distance-Time Graphs Elevator Operator (Line Graphs) Graphing Skills Prairie Ecosystem Reaction Time 1 (Graphs and Statistics) Reaction Time 2 (Graphs and Statistics)						*		
b. a table presenting variables or frequencies, or using a circular graph Gizmos: Box-and-Whisker Plots Describing Data Using Statistics Graphing Skills Histograms Reaction Time 1 (Graphs and Statistics) Reaction Time 2 (Graphs and Statistics) Stem-and-Leaf Plots						→ *		
c. a table of condensed data or data grouped into classes, a histogram, or box-and-whisker plot						*		CST
								TS
								S
						*		CST

b. measures of dispersion :				
a.i. range				
Gizmos: Adding on the Number Line Box-and-Whisker Plots Describing Data Using Statistics Reaction Time 1 (Graphs and Statistics) Reaction Time 2 (Graphs and Statistics)		→	★	
a.ii. range of each part of a box-and whisker plot, interquartile range			★	
a.iii. mean deviation			★	CST
			★	TS
				S
a.i. standard deviation				CST
			★	TS
				S
c. measures of position :				
a.i. minimum, maximum				
Gizmos: Adding on the Number Line Box-and-Whisker Plots Reaction Time 1 (Graphs and Statistics) Reaction Time 2 (Graphs and Statistics)		→	★	
a.ii. percentile a.ii.1. Note : Percentile is determined using a sufficient number of data. Students can also determine corresponding data from a percentile.			★	CST
				TS
				S
12. Chooses the appropriate statistical measures for a given situation Gizmos: Describing Data Using Statistics Mean, Median, and Mode Movie Reviewer (Mean and Median) Reaction Time 1 (Graphs and Statistics)		→	★	CST
				TS
				S

a. a regression line					★	TS
					★	S
a. the functional model best suited to the situation						CST
					★	TS
					★	S
10. Compares two-variable distributions					★	CST
					★	TS
					★	S

Geometry

Spatial sense and analyzing situations involving geometric figures						
→ ★ Student constructs knowledge with teacher guidance. Student applies knowledge by the end of the school year. Student reinvests knowledge.	Elementary	Secondary				
		Cycle One	Cycle Two			
A. Plane figures	6	1	2	3	4	5
1. Describes convex and nonconvex polygons						
2. Describes and classifies quadrilaterals Gizmos: Classifying Quadrilaterals - Activity B Parallelogram Conditions Special Parallelograms						
3. Describes and classifies triangles Gizmos: Classifying Triangles Parallelogram Conditions Pythagorean Theorem - Activity B Segment and Angle Bisectors	★					
4. Describes circles: radius, diameter, circumference, central angle Gizmos: Chords and Arcs Circumference and Area of Circles	★					

5. Recognizes and names regular convex polygons		★					
6. Decomposes plane figures into circles (sectors), triangles or quadrilaterals Gizmos: Segment and Angle Bisectors		→	★				
7. Describes circles and sectors		→	★				
8. Recognizes and draws main segments and lines							
a. diagonal, altitude, median, perpendicular bisector, bisector, apothem, radius, diameter, chord Gizmos: Chords and Arcs Segment and Angle Bisectors		→	★				
b. leg, hypotenuse				★			
9. Identifies the properties of plane figures using geometric transformations and constructions Note : See the Secondary Cycle One Mathematics program, p. 219. Gizmos: Classifying Triangles Parallelogram Conditions Quilting Bee (Symmetry) Special Parallelograms		→	★				
10. Justifies statements using definitions or properties ¹ of plane figures Gizmos: Classifying Triangles Parallelogram Conditions Special Parallelograms		→	★				
B. Solids	6	1	2	3	4	5	
1. Matches the net of a convex polyhedron to the corresponding convex polyhedron Gizmos:		★					

Surface and Lateral Areas of Pyramids and Cones									
2. Determines the possible nets of a solid Gizmos: Surface and Lateral Areas of Prisms and Cylinders Surface and Lateral Areas of Pyramids and Cones			→	★					
3. Names the solid corresponding to a net Gizmos: Surface and Lateral Areas of Prisms and Cylinders Surface and Lateral Areas of Pyramids and Cones			→	★					
4. Describes solids :									
a. vertex, edge, base, face		★							
b. altitude, apothem, lateral face Gizmos: Surface and Lateral Areas of Prisms and Cylinders			→	★					
5. Tests Euler's relation on convex polyhedrons Note : In CST in Secondary V, this relation can be put to use (planar graph). See Avenues of Exploration, Secondary Cycle Two Mathematics program, p. 124.		★							CST TS S
6. Recognizes solids that can be split into									
a. right prisms, right cylinders, right pyramids			→	★					
b. right cones and spheres					★				
7. Represents three-dimensional figures in the plane, using different procedures : o net o projection and perspective (e.g. orthogonal projections [different views], parallel projections [cavalier and axonometric perspectives] or central projections [with one or two vanishing points])						★			
C. Geometric constructions and transformations in the	6	1	2	3	4	5			

Euclidian plane ²						
1. Observes and produces frieze patterns and tessellations using reflections and translations	★					
2. Identifies properties and invariants resulting from geometric constructions and transformations Gizmos: Classifying Triangles Parallelogram Conditions Quilting Bee (Symmetry) Special Parallelograms		→	★			
3. Identifies congruence (translation, rotation and reflection) between two figures Gizmos: Quilting Bee (Symmetry) Reflections Rock Art (Transformations) Rotations, Reflections and Translations Translations		→	★			
4. Constructs the image of a figure under a translation, rotation and reflection Gizmos: Quilting Bee (Symmetry) Reflections Rock Art (Transformations) Rotations, Reflections and Translations Translations		→	★			
5. Recognizes dilatation with a positive scale factor Gizmos: Classifying Triangles Dilations Perimeters and Areas of Similar Figures		→	★			

<p>6. Constructs the image of a figure under a dilatation with a positive scale factor</p> <p>Gizmos: Classifying Triangles Dilations</p>			→★					
D. Congruent, similar or equivalent figures		6	1	2	3	4	5	
<p>1. Identifies congruent figures in frieze patterns and tessellations</p> <p>Gizmos: Perimeters and Areas of Similar Figures Similar Figures - Activity A</p>			★					
<p>2. Recognizes congruent or similar figures</p> <p>Gizmos: Perimeters and Areas of Similar Figures Similar Figures - Activity A</p>			→★					
<p>3. Recognizes the geometric transformation(s) linking a figure and its image</p> <p>Gizmos: Dilations Quilting Bee (Symmetry) Reflections Rock Art (Transformations) Rotations, Reflections and Translations</p>			→★					
<p>4. Determines the properties and invariants of congruent or similar figures</p> <p>Gizmos: Congruence in Right Triangles Perimeters and Areas of Similar Figures Similar Figures - Activity A</p>			→★					
<p>5. Determines the minimum conditions required to conclude that triangles are congruent or similar</p>					★			

Note : See Avenues of Exploration in Appendix E of the Secondary Cycle Two Mathematics program.								
6. Demonstrates the congruence or similarity between triangles or finds unknown measurements using minimum conditions						★		
7. Recognizes equivalent figures (plane figures or solids)						★	CST	
						★	TS	
						★	S	
8. Justifies statements using definitions or properties of congruent, similar or equivalent figures, depending on the cycle and year Gizmos: Congruence in Right Triangles Perimeters and Areas of Similar Figures Similar Figures - Activity A						→★		

Analyzing situations involving measurements ¹							
→ Student constructs knowledge with teacher guidance. ★ Student applies knowledge by the end of the school year. Student reinvests knowledge.	Elementary	Secondary					
		Cycle One	Cycle Two				
A. Mass	6	1	2	3	4	5	
1. Chooses the appropriate unit of mass for the context							
2. Estimates and measures mass using unconventional units: grams, kilograms	★						
3. Establishes relationships between units of mass	★						
B. Time	6	1	2	3	4	5	
1. Chooses the appropriate unit of time for the context							
2. Estimates and measures time using conventional units							

Classifying Triangles Fido's Flower Bed (Perimeter and Area) Parallelogram Conditions Perimeter and Area of Rectangles Special Parallelograms								
<p>b. a segment in a plane figure, circumference, radius, diameter, length of an arc, a segment resulting from an isometry or a similarity transformation</p> <p>Gizmos: Circumference and Area of Circles Dilations Quilting Bee (Symmetry) Reflections Rock Art (Transformations) Rotations, Reflections and Translations</p>		→	★					
<p>c. segments in a solid resulting from an isometry or a similarity transformation</p>				★				
<p>d. segments or perimeters resulting from equivalent figures</p>					★	CST		
					★	TS		
					★	S		
6. Justifies statements concerning measures of length		→	★					
E. Area	6	1	2	3	4	5		
<p>1. Chooses the appropriate unit of area for the context</p> <p>Gizmos: Area of Triangles</p>								
<p>2. Estimates and measures surface areas using conventional units: square centimetre, square decimetre, square metre</p> <p>Gizmos: Surface and Lateral Areas of Prisms and Cylinders Surface and Lateral Areas of Pyramids and Cones</p>		★						
3. Establishes relationships between SI units of area		→	★					

<p>Gizmos: Area of Triangles</p>							
<p>4. Constructs relations that can be used to calculate the area of plane figures: quadrilateral, triangle, circle (sectors)</p> <p>Note : Using relations established for the area of plane figures and the net of solids, students identify relationships to calculate the lateral or total area of right prisms, right cylinders and right pyramids.</p> <p>Gizmos: Area of Parallelograms Area of Triangles Circumference and Area of Circles Fido's Flower Bed (Perimeter and Area) Perimeter and Area of Rectangles Segment and Angle Bisectors</p>		→	★				
<p>5. Uses relations that can be used to calculate the area of a right cone and a sphere</p>			★				
<p>6. Finds unknown measurements, using properties of figures and relations</p>							
<p>a. area of circles and sectors</p>		→	★				
<p>b. area of figures that can be split into circles (sectors), triangles or quadrilaterals</p> <p>Gizmos: Fido's Flower Bed (Perimeter and Area) Segment and Angle Bisectors</p>		→	★				
<p>c. lateral or total area of right prisms, right cylinders and right pyramids</p> <p>Gizmos: Surface and Lateral Areas of Prisms and Cylinders</p>		→	★				
<p>d. lateral or total area of solids that can be split into right prisms, right cylinders or right pyramids</p>		→	★				

a. capacity units : millilitre, litre								
b. measures of capacity				★				
c. measures of volume and of capacity				★				
5. Constructs relations that can be used to calculate volumes: right cylinders, right pyramids, right cones and spheres				★				
6. Finds unknown measurements using properties of figures and relations								
a. volume of right prisms, right cylinders, right pyramids, right cones and spheres				★				
b. volume of solids that can be split into right prisms, right cylinders, right pyramids, right cones and spheres				★				
c. volume solids resulting from an isometry or a similarity transformation c.i. Note : In similar solids, the ratio of the volumes is equal to the cube of the similarity ratio.				★				
d. volume of equivalent solids							★	CST
							★	TS
							★	S
7. Justifies statements concerning measures of volume or capacity				★				
G. Metric or trigonometric relations								
1. Determines, through exploration or deduction, different metric relations associated with plane figures Gizmos: Perimeters and Areas of Similar Figures Similar Figures - Activity A							→	→
2. Finds unknown measurements in various situations								
a. in a right triangle rectangle using								
a.i. Pythagorean relation				★				
a.ii. the following metric relations a.ii.1. The length of a leg of a right triangle is the geometric mean between the length of its projection on the hypotenuse and the					★			

2. Defines algebraically the rule for a geometric transformation Note : In TS, students may also use a matrix to define a geometric transformation.						*	TS
							S
3. Constructs, in the Cartesian plane, the image of a figure using a transformation rule Note :In TS, students also determine the vertices of an image using a matrix.						*	CST
						*	TS
							S
4. Anticipates the effect of a geometric transformation on a figure						*	CST
						*	TS
							S
D. Geometric loci	6	1	2	3	4	5	
1. Describes, represents and constructs geometric loci in the Euclidian and Cartesian planes, with or without technological tools Note : In S, the study of geometric loci is limited to conics.							CST
						*	TS
						*	S
2. Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian planes Note : In TS, geometric loci also include plane loci, i.e. geometric loci involving lines or circles only. In S, the study of geometric loci is limited to conics.							CST
						*	TS
						*	S
3. Analyzes and models situations using conics <ul style="list-style-type: none"> o describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions o graphing a conic and its internal and external region o constructing the rule of a conic based on its definition o finding the rule (standard form) of a conic and its internal and external region o validating and interpreting the solution, if necessary 							
a. parabola centred at the origin and resulting from a translation							CST
						*	TS
						*	S
a. circle, ellipse and hyperbola centred at the origin							CST
						*	TS
						*	S
a. circle, ellipse and hyperbola resulting from a translation							CST
						*	TS
							S

4. Determines the coordinates of points of intersection between								
a. a line and a conic a.i. Note : In TS, this is associated with solving systems involving the functional models under study and entails mostly graphical solutions (with or without the use of technological tools).								CST
							*	TS
							*	S
a. two conics (a parabola and a conic)								CST
								TS
							*	S
E. Standard unit circle								
1. Establishes the relationship between trigonometric ratios and the standard unit circle (trigonometric ratios and lines)	6	1	2	3	4	5		
								CST
							*	TS
2. Determines the coordinates of points associated with significant angles using metric relations in right triangles (Pythagorean relation, properties of angles: 30°, 45°, 60°)								CST
							*	TS
							*	S
3. Analyzes and uses periodicity and symmetry to determine coordinates of points associated with significant angles in the standard unit circle								CST
							*	TS
							*	S
4. Proves Pythagorean identities								CST
							*	TS
							*	S

Discrete Mathematics

Introduction to graph theory		
→ Student constructs knowledge with teacher guidance. ★ Student applies knowledge by the end of the school year.	Elementary	Secondary

Student reinvests knowledge.						
	Cycle One	Cycle Two				
A C	6	1	2	3	4	5
1. Describes the basic elements of graph theory: degree distance, path, circuit						★ CST TS S
2. Recognizes Euler paths or circuits and Hamiltonian paths or circuits						★ CST TS S
3. Constructs graphs: directed graphs, weighted graphs, coloured graphs, trees						★ CST TS S
4. Identifies properties of graphs						★ CST TS S
B. Situation analysis, optimization and decision making	6	1	2	3	4	5
1. Determines elements of a situation associated with vertices and edges						★ CST TS S
2. Represents a situation using a graph						★ CST TS S
3. Compares graphs, if necessary						★ CST TS S
4. Finds Euler and Hamiltonian paths and circuits, the critical path, the shortest path, the tree of minimum or maximum values or the chromatic number, depending on the situation						★ CST TS S

Introduction to social choice theory

applies knowledge by the end of the school year. Student reinvests knowledge.						
		Cycle One	Cycle Two			
	6	1	2	3	4	5
1. Understands tables of numbers: lines, columns						
2. Represents, interprets data using matrices						→
						CST
						TS
3. Performs operations on matrices: addition and subtraction, multiplication with a scalar and with another matrix						→
						CST
						TS
4. Performs geometric transformations (transformation matrices)						→
						★
						TS
5. Solves systems of equations (augmented matrix)						→
						CST
						TS
						S