

Québec Education Program Progression of Learning

Mathematics

Secondary Cycle One

2021-2022 School Year

Learning to Be Prioritized for the 2021-2022 School Year in the Context of the Pandemic

Changes have been made to the version produced for the 2020-2021 school year. (See p.34)





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Progression of Learning in Secondary School

The progression of learning in secondary school constitutes a complement to each school subject, providing further information on the knowledge that the students must acquire and be able to use in each year of secondary school. This tool is intended to assist teachers in planning both their teaching and the learning that their students are to acquire.

The role of knowledge in learning

The knowledge that young people acquire enables them to better understand the world in which they live. From a very early age, within their families and through contact with the media and with friends, they accumulate and learn to use an increasingly greater body of knowledge. The role of the school should be to progressively broaden, deepen and structure this knowledge.

Knowledge and competencies must mutually reinforce each other. On the one hand, knowledge becomes consolidated when it is used and, on the other hand, the exercise of competencies entails the acquisition of new knowledge. Helping young people acquire knowledge raises the challenging question of how to make this knowledge useful and durable, and thus evokes the notion of competency. For example, we can never be really assured that a grammar rule has been assimilated until it is used appropriately in a variety of texts and contexts that go beyond the confines of a repetitive, targeted exercise.

Intervention by the teacher

The role of the teacher in knowledge acquisition and competency development is essential, and he or she must intervene throughout the learning process. In effect, the *Education Act* confers on the teacher the right to "select methods of instruction corresponding to the requirements and objectives fixed for each group or for each student entrusted to his care." It is therefore the teacher's responsibility to adapt his or her instruction and to base it on a variety of strategies, whether this involves lecture-based teaching for the entire class, individualized instruction for a student or a small group of students, a series of exercises to be done, a team activity or a particular project to be carried out.

In order to meet the needs of students with learning difficulties, teachers should encourage their participation in the activities designed for the whole class, although support measures should also be provided, when necessary. These might involve more targeted teaching of certain key elements of knowledge, or they might take the form of other specialized interventions.

As for the evaluation of learning, it serves two essential functions. Firstly, it enables us to look at the students' learning in order to guide and support them effectively. Secondly, it enables us to verify the extent to which the students have acquired the expected learning. Whatever its function, in accordance with the *Policy on the Evaluation of Learning*, evaluation should focus on the acquisition of knowledge and the students' ability to use this knowledge effectively in contexts that draw upon their competencies.

Structure

The progression of learning is presented in the form of tables that organize the elements of knowledge similarly to the way they are organized in the subject-specific programs. In mathematics, for example, learning is presented in fields: arithmetic, geometry, etc. For subjects that continue on from elementary school, the *Progression of Learning in Secondary School* has been harmonized with the *Progression of Learning in Elementary School*. Every element of learning indicated is associated with one or more years of secondary school during which it is formally taught.

A uniform legend is used for all subjects. The legend employs three symbols: an arrow, a star and a shaded box. What is expected of the student is described as follows:



An **arrow** indicates that teaching must be planned in a way that enables students to begin acquiring knowledge during the school year and continue or conclude this process in the following year, with ongoing systematic intervention from the teacher.

A star indicates that the teacher must plan for the majority of students to have acquired this knowledge by the end of the school year.

A shaded box indicates that the teacher must plan to ensure that this knowledge will be applied during the school year.

Introduction

Mathematics is a science that involves abstract concepts and language. Students develop their mathematical thinking gradually through personal experiences and exchanges with peers. Their learning is based on situations that are often drawn from everyday life. In elementary school, students take part in learning situations that allow them to use objects, manipulatives, references and various tools and instruments. The activities and tasks suggested encourage them to reflect, manipulate, explore, construct, simulate, discuss, structure and practise, thereby allowing them to assimilate concepts, processes and strategies¹ that are useful in mathematics. Students must also call on their intuition, sense of observation, manual skills as well as their ability to express themselves, reflect and analyze. By making connections, visualizing mathematical objects in different ways and organizing these objects in their minds, students gradually develop their understanding of abstract mathematical concepts. With time, they acquire mathematical knowledge and skills, which they learn to use effectively in order to function in society.

In secondary school, learning continues in the same vein. It is centred on the fundamental aims of mathematical activity: interpreting reality, generalizing, predicting and making decisions. These aims reflect the major questions that have led human beings to construct mathematical culture and knowledge through the ages. They are therefore meaningful and make it possible for students to build a set of tools that will allow them to communicate appropriately using mathematical language, to reason effectively by making connections between mathematical concepts and processes, and to solve situational problems. Emphasis is placed on technological tools, as these not only foster the emergence and understanding of mathematical concepts and processes, but also enable students to deal more effectively with various situations. Using a variety of mathematical concepts and strategies appropriately provides keys to understanding everyday reality. Combined with learning activities, everyday situations promote the development of mathematical skills and attitudes that allow students to mobilize, consolidate and broaden their mathematical knowledge. In Cycle Two, students continue to develop their mathematical thinking, which is essential in pursuing more advanced studies.

This document provides additional information on the knowledge and skills students must acquire in each year of secondary school with respect to arithmetic, algebra, geometry, statistics and probability. It is designed to help teachers with their lesson planning and to facilitate the transition between elementary and secondary school and from one secondary cycle to another. A separate section has been designed for each of the above-mentioned branches, as well as for discrete mathematics, financial mathematics and analytic geometry. Each section consists of an introduction that provides an overview of the learning that was acquired in elementary school and that is to be acquired in the two cycles of secondary school, as well as content tables that outline, for every year of secondary school, the knowledge to be developed and actions to be carried out in order for students to fully assimilate the concepts presented. A column is devoted specifically to learning acquired in elementary school.² Where applicable, the cells corresponding to Secondary IV and V have been subdivided to present the knowledge and actions associated with each of the options that students may choose based on their interests, aptitudes and training needs: *Cultural, Social and Technical* option (CST), *Technical and Scientific* option (TS) and *Science* option (S).

^{1.} Examples of strategies are provided in the Appendix.

^{2.} Information concerning learning acquired in elementary school was taken from the *Mathematics program* and the document *Progression of Learning in Elementary School - Mathematics*, to indicate its relevance as a prerequisite and to define the limits of the elementary school program. Please note that there are no sections on vocabulary or symbols for at the secondary level, these are introduced gradually as needed.

Arithmetic

In elementary school,¹ students developed their understanding of numbers and operations involving natural numbers less than 1 000 000, fractions and decimals up to thousandths. They identified the properties of operations as well as the relationships between them and learned to follow the order of operations in simple sequences of operations involving natural numbers. They were introduced to the concept of integers and performed operations with natural numbers and decimals mentally, in writing and using technological tools. They also used objects and diagrams to perform certain operations involving fractions.

In Secondary Cycle One, students continue to develop their number sense, to perform operations on written numbers in decimal and fractional notation, and to further their understanding of the processes associated with these operations. The numbers are positive or negative, without restrictions as to the order of magnitude. Students also develop proportional reasoning, an essential concept that has many applications both within and outside mathematics. For example, students use percentages (calculating a certain percentage of a number and the value corresponding to 100 per cent) in various situations involving discounts, taxes, increases, decreases, etc. They also make scale drawings and represent data using circle graphs. They look for unknown values in algebraic or geometric situations involving similarity transformations, arc lengths, sector areas or unit conversions.

In Secondary Cycle Two, students assimilate the concept of real numbers (rational and irrational), particularly in situations involving exponents, radicals or logarithms.

The following tables present the learning content associated with arithmetic. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

- Understanding real numbers
- Understanding operations involving real numbers
- Operations involving real numbers
- Understanding and analyzing proportional situations
- 1. Given the scope of this branch in elementary school, we recommend that you consult the document <u>Progression of</u> <u>Learning in Elementary School — Mathematics</u> for more information on the concepts and processes acquired by students.

Arithmetic

Understanding real numbers

	Understanding real numbers						
→ Stu	ident constructs knowledge with teacher guidance.			Sec	ond	ary	
\star Stu	dent applies knowledge by the end of the school year.		Cv	cle	C	.vcle	2
Stu	ident reinvests knowledge. ¹		0	ne		Two	-
		6	1	2	3	4	5
1. Natu	ural 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)	*					
2. <mark>Frac</mark>	ztions						
a.	Represents a fraction in a variety of ways (using objects or drawings)	*					
b.	Identifies the different meanings of fractions: part of a whole, division, ratio,						
	operator, measurement)	→	→	*			
C.	Operator, measurement Verifies whether two fractions are equivalent	→ ★	→	*			
c. d.	(operator, measurement) Verifies whether two fractions are equivalent Compares a fraction to $0, \frac{1}{2}$ or 1	→ ★	→	*			
c. d. e.	Operator, measurement Verifies whether two fractions are equivalent Compares a fraction to 0, $\frac{1}{2}$ or 1 Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numerator	→ ★	→	*			
c. d. e. 3. Dec	Operator, measurementVerifies whether two fractions are equivalentCompares a fraction to $0, \frac{1}{2}$ or 1Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numeratorimals up to thousandths	→	→	*			
c. d. e. 3. Dec a.	Operator, measurementVerifies whether two fractions are equivalentCompares a fraction to $0, \frac{1}{2}$ or 1Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numeratorimals up to thousandthsRepresents decimals in a variety of ways (using objects or drawings) and identifies equivalent representations	→	→	*			
c. d. e. 3. Dec a. b.	operator, measurement Verifies whether two fractions are equivalent Compares a fraction to 0, $\frac{1}{2}$ or 1 Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numerator imals up to thousandths Represents decimals in a variety of ways (using objects or drawings) and identifies equivalent representations Reads and writes numbers written in decimal notation	→ ★ ★	→	*			
c. d. e. 3. Dec a. b. c.	operator, measurement Verifies whether two fractions are equivalent Compares a fraction to 0, $\frac{1}{2}$ or 1 Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numerator imals up to thousandths Represents decimals in a variety of ways (using objects or drawings) and identifies equivalent representations Reads and writes numbers written in decimal notation Approximates a number written in decimal notation	→ ★ ★ ★ ★ ★ ★	→	*			
C. d. e. 3. Dec a. b. c. d.	operator, measurement Verifies whether two fractions are equivalent Compares a fraction to 0, $\frac{1}{2}$ or 1 Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numerator imals up to thousandths Represents decimals in a variety of ways (using objects or drawings) and identifies equivalent representations Reads and writes numbers written in decimal notation Approximates a number written in decimal notation Composes and decomposes a number written in decimal notation and recognizes equivalent expressions	→ ★ <p< td=""><td>→</td><td>*</td><td></td><td></td><td></td></p<>	→	*			
c. d. e. 3. Dec a. b. c. d. e.	operator, measurement Verifies whether two fractions are equivalent Compares a fraction to 0, $\frac{1}{2}$ or 1 Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numerator imals up to thousandths Represents decimals in a variety of ways (using objects or drawings) and identifies equivalent representations Reads and writes numbers written in decimal notation Approximates a number written in decimal notation Composes and decomposes a number written in decimal notation and recognizes equivalent expressions Compares numbers written in decimal notation or arranges them in increasing or decreasing order	→ ★ <p< td=""><td></td><td>*</td><td></td><td></td><td></td></p<>		*			
c. d. e. 3. Dec a. b. c. d. c. d. e. 4. Integ	Operator, measurement Verifies whether two fractions are equivalent Compares a fraction to 0, $\frac{1}{2}$ or 1 Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numerator imals up to thousandths Represents decimals in a variety of ways (using objects or drawings) and identifies equivalent representations Reads and writes numbers written in decimal notation Approximates a number written in decimal notation Compares numbers written in decimal notation and recognizes equivalent expressions Compares numbers written in decimal notation or arranges them in increasing or decreasing order	→ ★ <p< td=""><td></td><td>*</td><td></td><td></td><td></td></p<>		*			
c. d. e. 3. Dec a. b. c. d. c. d. e. 4. Integ	Operator, measurementVerifies whether two fractions are equivalentCompares a fraction to 0, $\frac{1}{2}$ or 1Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numeratorimals up to thousandthsRepresents decimals in a variety of ways (using objects or drawings) and identifies equivalent representationsReads and writes numbers written in decimal notationApproximates a number written in decimal notationComposes and decomposes a number written in decimal notation and recognizes equivalent expressionsCompares numbers written in decimal notation or arranges them in increasing or decreasing ordergersRepresents integers in a variety of ways (using objects or drawings)	→ ★ <p< td=""><td></td><td>*</td><td></td><td></td><td></td></p<>		*			
C. d. e. 3. Dec a. b. c. d. d. e. 4. Integ a. b.	Operator, measurement)Verifies whether two fractions are equivalentCompares a fraction to 0, $\frac{1}{2}$ or 1Orders fractions with the same denominator or where one denominator is a multiple of the other or with the same numeratorimals up to thousandthsRepresents decimals in a variety of ways (using objects or drawings) and identifies equivalent representationsReads and writes numbers written in decimal notationApproximates a number written in decimal notationComposes and decomposes a number written in decimal notation and recognizes equivalent expressionsCompares numbers written in decimal notation or arranges them in increasing or decreasing ordergersRepresents integers in a variety of ways (using objects or drawings)Reads and writes integers	→ ★ <p< td=""><td></td><td></td><td></td><td></td><td></td></p<>					

5. Expresses numbers in a variety of ways (fractional, decimal percentage notation)	*						
6. (Represents, reads and writes numbers written in fractional or decimal notation)		*					
 Approximates, in various contexts, the numbers under study (e.g. estimates, rounds off, truncates) 		*					
 Distinguishes rational numbers from irrational numbers in the set of real numbers 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). 				*			
 Represents, in different types of notation, various subsets of real numbers (discrete or continuous): interval, list/roster, on a number line Note : In TS and S, set builder notation may be introduced as needed. 				*			
 Defines the concept absolute value in context (e.g. difference between two numbers, distance between two points) Note : In Cycle One and Secondary III, the concept of <i>absolute value</i> is introduced informally, using examples. 		→	÷	→	*		
^{11.} (Represents and writes)							
a. the power of a natural number	*						
b. squares and square roots		→	*				
c. (numbers in exponential notation (integral exponent)		→	*				
d. numbers in scientific notation				*			
e. cubes and cube roots				*			
f. numbers in exponential notation (fractional exponents)				*			CCT
g. numbers using radicals or rational exponents					*	*	TS S
h. numbers in logarithmic notation using the equivalence $\log_a x = n \Leftrightarrow a^n = x$, if necessary					→	* *	CST TS S
 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 penative integral or fractional). 				\rightarrow	*		CST TS
Note : The same applies for a logarithmic expression in TS and S.					~	*	S
13. Estimates the order of magnitude of a real number in different contexts	\rightarrow	\rightarrow	\rightarrow	*			
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)		*					
 b. (numbers expressed in different ways (fractional, decimal, exponential) (fintegral exponent], percentage, square root, scientific notation) (Note : Scientific notation is introduced in Secondary III) 		→	*				

1. Mathematical knowledge is constructed using prerequisites or by making connections between concepts and processes. The elements described in the tables will be reinvested and further developed as students progress through secondary school. When actions are included as part of other actions carried out in subsequent years, the shading in the table is not extended to cover all five years of secondary school.

Arithmetic

Understanding operations involving real numbers

Understanding operations involving real numbers						
 Student constructs knowledge with teacher guidance. Student applies knowledge by the end of the school year. 			Sec	ond	ary	
Student reinvests knowledge.		Cy Oi	<mark>cle</mark> ne	C	ycle Two	9
	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	*					
 b. Uses objects, diagrams or equations to represent a situation and, conversely, describes a situation represented by objects, diagrams or equations (use of <u>different meanings of the four operations</u>) 	*					
c. Establishes equality relations between numerical expressions (e.g. $3 + 2 = 6 - 1$)	*					
 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 	*					
e. Translates a situation using a sequence of operations in accordance with the order of operations	*					
2. (Fractions)						
 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) 	*					
 b. Uses an operation to represent a situation (use of different meanings of operations) 	÷	*				
3. Decimals						
 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) 	*					
 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 	*					
c. Translates a situation using a sequence of operations in accordance with the order of operations	*					
 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. 	*					
5. Looks for equivalent expressions: decomposing (additive, multiplicative, etc.), equivalent fractions, simplifying and reducing, factoring, etc.		*				
6. Translates (mathematizes) a situation using a sequence of operations (no more than two levels of parentheses)		*				
7. Anticipates the results of operations		*				
8. (Interprets the results of operations in light of the context)		*				

Arithmetic

Operations involving real numbers

		_			_	_
Operations involving real numbers						
→ Student constructs knowledge with teacher guidance.	NIV		Sec	ond	ary	
* Student applies knowledge by the end of the school year.	nemta					
Student reinvests knowledge.	Elen	Cy Ol	cle ne	(Cycle Two	e
	6	1	2	3	4	5
1. Natural numbers less than 1 000 000						
a. Approximates the result of an operation	*					
b. Using personal processes, mentally computes operations	*					
 c. Determines in writing the sum of two natural numbers of up to 4 digits 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 	*					
2. Fractions (using objects or diagrams)						
a. Generates a set of equivalent fractions	*					
b. Reduces a fraction to its simplest form	*					
 Adds and subtracts fractions when the denominator of one fraction is a multiple of the other fraction 	*					
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	*					
 b. Mentally computes operations (addition, subtraction, multiplication, division by a natural number) multiplications by 10, 100, 1000 	*					
 c. Computes in writing additions and subtractions of numbers whose result does not go beyond the second decimal place multiplications of numbers whose product does not go beyond the second decimal place divisions of a decimal by a natural number less than 11 	*					
4. Properties of divisibility						
a. Determines the divisibility of a number by 2, 3, 4, 5, 6, 8, 9 and 10	*					
b. Uses, in different contexts, the properties of divisibility: 2, 3, 4, 5 and 10		*				
5. Approximates the result of an operation or sequence of operations		→	*			

 Computes, in writing, the four operations¹ with numbers that are easy to work with (including large numbers)) and including numbers and the properties of operations a. numbers written in decimal notation, using rules of signs) b. positive numbers written in fractional notation, with or without the use of objects or diagrams c. numbers written in fractional notation c. numbers and the order of operations. (numbers written in decimal notation) in accordance with the order of operations (with no more than two levels) of parentheses) c. Computes, using a calculator, operations and sequences of operations in accordance with the order of operations. (norm decimal to parenthase) c. Switches, as needed, from one way of writing numbers to another: from fractional to parenthage notation, and vice versa 10. Switches, as needed, from one way of writing numbers to another: from fractional to parenthage notation, and vice versa 11. Switches, as needed, from one way of writing numbers to another: from fractional to parenthage notation, and vice versa 12. Calculates the power of a natural number 13. Decomposes a natural number into prime factors a. integral exponents (rational base) and fractional exponents in Secondary (with withing numerical expressions, students learn to deduce the properties of powers. b. powers of bases (change of base), exponents, radicals (rith root), using their properties where subses 2 and 10. h S, students learn to deduce the properties of powers. c. logarithms i. properties 	 Mentally computes the four operations, especially with numbers notation, using equivalent ways of writing numbers and the prop operations 	written in decimal) erties of		<mark>→</mark>	*			
a. numbers written in decimal notation, using rules of signs <	 Computes, in writing, the four operations¹ with numbers that are using equivalent ways of writing numbers and the properties of 	easy to work with (operations	inclu	<mark>iding</mark>	larg	<mark>e nu</mark>	mber	rs),
b. positive numbers written in fractional notation, with or without the use of objects or diagrams Image: Im	a. numbers written in decimal notation, using rules of signs			*				
c. numbers written in fractional notationIII <tdi< td=""><tdi< td="">III<tdi< <="" td=""><td> b. positive numbers written in fractional notation, with or with objects or diagrams </td><td>out the use of</td><td></td><td><mark>→</mark></td><td>*</td><td></td><td></td><td></td></tdi<></tdi<></tdi<>	 b. positive numbers written in fractional notation, with or with objects or diagrams 	out the use of		<mark>→</mark>	*			
 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) 9. Computes, using a calculator, operations and sequences of operations in accordance with the 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 11. Switches, as needed, from one way of writing numbers to another? Net: P Secondary Cycle One, the students should use pocitive numbers when writching from one way of writing numbers to another? Net: P Secondary Cycle Two, new types of notation are introduced? 12. Calculates the power of a natural number 13. Decomposes a natural number into prime factors 14. Manipulates numerical expressions involving a. integral exponents (rational base) and fractional scentes the properties of powers. b. powers of bases (change of base), exponents, radicals (<i>r</i>th root), using their properties or properties. Note: in CST radicals and their properties are not overed. For base changes in TS in Secondary Vistudents learn to deduce the properties of powers. c. logarithms i. definition and change of base ii. properties ii. properties ii. properties ii. properties ii. properties ii. absolute values 	c. numbers written in fractional notation					*		
9. Computes, using a calculator, operations and sequences of operations in accordance with the order of operations Image: Computes, 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 Image: Computes, as needed, from one way of writing numbers to another: from fractional to percentage notation, and vice versa Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, as needed, from one way of writing numbers to another Image: Computes, another Image: Computes, another Image: Computes, another Image: Compute sector	 Computes, in writing, sequences of operations (numbers written notation) in accordance with the order of operations, using equiv writing numbers and the properties of operations (with no more parentheses) 	in decimal) valent ways of) than two levels of)		*				
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 Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Switches, as needed, from one way of writing numbers to another) Secondary Cycle One, the students should use positive numbers when switching from one type of notation etc. Calculates the power of a natural number Science (Calculates in the properties in the properties of powers. Note : When manipulating numerical expressions, students learn to deduce the properties of powers. Note : In CST, radicals and their properties are not covered. For base changes in TS in Secondary N, students use bases 2 and 10. h S, students learn to deduce the properties of radicals. I an of the properties is a not covered. For base changes in TS in Secondary N, students use bases 2 and 10. h S, students learn to	9. Computes, using a calculator, operations and sequences of operations and sequences of operations	rations in		*				
11. Switches, as needed, from one way of writing numbers to another Note: In Secondary Cycle Due, the students should use positive numbers when switching from one by portion to another. In Secondary Cycle Two, new types of notation are introduced? 12. Calculates the power of a natural number 13. Decomposes a natural number into prime factors 14. Manipulates numerical expressions involving a. integral exponents (rational base) and fractional exponents Note: When manipulating numerical expressions, students learn to deduce the properties of provers. b. powers of bases (change of base), exponents, radicals (<i>rth</i> root), using their properties Note: In CST, radicals and their properties are not covered. For base changes in TS in Secondary M, students use bases 2 and 10. In S, students learn to deduce the properties of radicals. i. definition and change of base ii. properties ii. properties ii. properties ii. definition and change of base ii. properties ii. properties ii. definition and change of base ii. absolute values	 Switches, as needed, from one way of writing numbers to anothe to percentage notation, from decimal to fractional notation, from percentage notation, and vice versa 	er: from fractional decimal to	*					
Note:	11. Switches, as needed, from one way of writing numbers to anoth	er						
12. Calculates the power of a natural number * </td <td>Note : In Secondary Cycle One, the students should use positive numbers where type of notation to another. In Secondary Cycle Two, new types of notation are exponential, scientific notation, etc.</td> <td>en switching from one introduced:</td> <td></td> <td>→</td> <td>*</td> <td></td> <td></td> <td></td>	Note : In Secondary Cycle One, the students should use positive numbers where type of notation to another. In Secondary Cycle Two, new types of notation are exponential, scientific notation, etc.	en switching from one introduced:		→	*			
13. Decomposes a natural number into prime factors Manipulates numerical expressions involving a. integral exponents (rational base) and fractional exponents Note: When manipulating numerical expressions, students learn to deduce the properties of powers. b. powers of bases (change of base), exponents, radicals (<i>n</i>th root), using their properties Note: In CST, radicals and their properties are not covered. For base changes in TS in Secondary V, students use bases 2 and 10. In S, students learn to deduce the properties of radicals. Image: Compose Comp	12. Calculates the power of a natural number		*					
14. Manipulates numerical expressions involving a. integral exponents (rational base) and fractional exponents Note : When manipulating numerical expressions, students learn to deduce the properties of powers. Image: Comparison of	13. Decomposes a natural number into prime factors		*					
a. integral exponents (rational base) and fractional exponents Note : When manipulating numerical expressions, students learn to deduce the properties of powers. Image: Comparison of bases (change of base), exponents, radicals (<i>n</i> th root), using their properties Note : In CST, radicals and their properties are not covered. For base changes in TS in Secondary N, students use bases 2 and 10. In S, students learn to deduce the properties of radicals. Image: Comparison of base (change of base), exponents, radicals (<i>n</i> th root), using their properties Note : In CST, radicals and their properties are not covered. For base changes in TS in Secondary N, students use bases 2 and 10. In S, students learn to deduce the properties of radicals. Image: Comparison of the temperties of radicals. c. logarithms Image: Comparison of temperties of temperties of radicals. Image: Comparison of temperties of temperties of radicals. i. definition and change of base Image: Comparison of temperties of tempertis of temperties of temperties of temperties of temperti	14. Manipulates numerical expressions involving							
Note : When manipulating numerical expressions, students learn to deduce the properties of powers. b. powers of bases (change of base), exponents, radicals (<i>n</i> th root), using their properties Note : In CST, radicals and their properties are not covered. For base changes in TS in Secondary V, students use bases 2 and 10. In S, students learn to deduce the properties of radicals. c. logarithms i. definition and change of base ii. properties ii. properties d. absolute values	a. integral exponents (rational base) and fractional exponents	6						
b. powers of bases (change of base), exponents, radicals (<i>n</i> th root), using their properties Note : In CST, radicals and their properties are not covered. For base changes in TS in Secondary IV, students use bases 2 and 10. In S, students learn to deduce the properties of radicals. c. logarithms i. definition and change of base i. properties d. absolute values	Note : When manipulating numerical expressions, students learn to de powers.	duce the properties of				*		
properties Note : In CST, radicals and their properties are not covered. For base changes in TS in Secondary N, students use bases 2 and 10. In S, students learn to deduce the properties of radicals. c. logarithms i. definition and change of base ii. properties d. absolute values	b. powers of bases (change of base), exponents, radicals (nt	h root), using their						\star
i. definition and change of base iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	properties	as in TS in Secondary					\rightarrow	\star
c. logarithms i. definition and change of base ii. properties d. absolute values	IV, students use bases 2 and 10. In S, students learn to deduce the properties	s of radicals.						*
i. definition and change of base ii. properties d. absolute values iii. base iii. properties i	c. logarithms							
i. definition and change of base i. i. <td< td=""><td>, definition and change of base</td><td></td><td></td><td></td><td></td><td></td><td></td><td>*</td></td<>	, definition and change of base							*
ii. properties d. absolute values I I I I							*	+
ii. properties								×
d. absolute values	ii. properties							*
d. absolute values								\star
d. absolute values								
	d. absolute values							

1. Students use technological tools for operations in which the divisors or multipliers have more than two digits; however, for written computation, the understanding and mastery of the processes is more important than the ability to do complex calculations.

Arithmetic

Understanding and analyzing proportional situations

	Understanding and analyzing proportional situation	S					
\rightarrow	Student constructs knowledge with teacher guidance.			Sec	ond	ary	
*	Student applies knowledge by the end of the school year.						
	Student reinvests knowledge.		Cy Oi	cle ne	C	ycle Two	9
		6	1	2	3	4	5
1.	Calculates						
	a. a certain percentage of a number	\rightarrow	*				
	b. (the value corresponding to 100 per cent)		→	*			
2.	Recognizes ratios and rates		→	*			
3.	Interprets ratios and rates		\rightarrow	*			
4.	Describes the effect of changing a term in a ratio or rate		→	*			
5.	Compares						
	a. (ratios and rates qualitatively (equivalent rates and ratios, unit rate)		\rightarrow	*			
	b. (ratios and rates quantitatively (equivalent rates and ratios, unit rate)		\rightarrow	*			
6.	Translates a situation using a ratio or rate Note : Situations involving ratios and rates are enriched in Secondary Cycle Two (similarity ratio, metric relations, etc.).		<mark>→</mark>	*			
7.	Recognizes a proportional situation using the context, a table of values or a graph		→	*			
8.	Represents or interprets a proportional situation using a graph, a table of values or a proportion		→	*			
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])		→	*			
10.	Establishes relationships between first-degree or rational functions and proportional situations (direct or inverse variation)				*		

Algebra

Through their various mathematical activities in elementary school, students were introduced to prerequisites for algebra, such as finding unknown terms using properties of operations and relationships between these operations, developing an understanding of equality and equivalence relationships, following the order of operations and looking for patterns in different situations.

In Secondary Cycle One, students move from arithmetic thinking to algebraic thinking. They use and further develop their understanding of numbers, operations and proportionality. For example, in studying patterns, elementary school students learned to determine rules for constructing number sequences between terms, whereas in secondary school, students learn to establish the relationship between a term and its rank. Algebraic expressions are added to known registers (types) of representation to observe situations from different perspectives. Students refine their ability to switch from one register of representation to another in order to analyze situations in the register(s) of their choice. Thus, they learn to manipulate algebraic expressions with or without technological aids, and interpret tables of values and graphs. The use of technology makes it easier to explore and examine these relationships in greater depth and makes it possible to describe and explain them more fully. Lastly, students learn to search for mathematical models representing various situations.

In Secondary Cycle Two, students hone their ability to evoke a situation by drawing on several registers of representation and switching from one register to another, without any restrictions. For example, functions may be represented using graphs, tables or rules, and each of these representations conveys a specific point of view and is complementary or equivalent to other types of representation. Students learn to analyze and deal with situations that involve a set of algebraic concepts and processes. They establish dependency relationships between variables; model, compare and optimize situations, if necessary; and make informed decisions about these situations, depending on the case.

The following tables present the learning content associated with algebra. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

- Understanding and manipulating algebraic expressions
- Understanding dependency relationships

Algebra

Understanding and manipulating algebraic expressions

Understanding and manipulating algebraic expressi	ons						
→ Student constructs knowledge with teacher guidance.			Se	cond	larv		
★ Student applies knowledge by the end of the school year.							
Student reinvests knowledge.		Cy	cle ne	(Cycle Two	9	
A. Algebraic expressions	6	1	2	3	4	5	
 Describes, using his/her own words and mathematical language, numerical patterns 							
Describes, using his/her own words and mathematical language, series of numbers and family of operations	*						
3. Adds new terms to a series when the first three terms or more are given	*						
4. Describes the role of components of algebraic expressions:							
a. unknown Note : This concept was introduced in elementary school (although not named as such) when students were asked to find a missing term.	÷	→	*				
b. variable, constant		\rightarrow	*				
 c. parameter Note : The concept of parameter is introduced intuitively (although not named as such) in Secondary I, II and III. 		÷	÷	÷	→ *	*	C
d. coefficient, degree, term, constant term, like terms		\rightarrow	*		~		
5. Constructs an algebraic expression using a register (type) of representation		→	*				
6. (Interprets an algebraic expression in light of the context)		→	*				
7. Recognizes or constructs equivalent algebraic expressions		→	*				
8. Recognizes or constructs							
a. equalities and equations	\rightarrow	→	*				
b. inequalities				*			
B. Manipulating algebraic expressions	6	1	2	3	4	5	
1. Calculates the numeric value of an algebraic expression		\rightarrow	*				
2. Performs the following operations on algebraic expressions, with or without objects or diagrams: addition and subtraction, multiplication and division by a		→	*				
constant, multiplication of first-degree monomials							
 3. Factors out the common factor in numerical expressions (distributive property of multiplication over addition or subtraction) 		→	*				
 constant, multiplication of first-degree monomials 3. Factors out the common factor in numerical expressions (distributive property of multiplication over addition or subtraction) 4. Multiplies 		→	*				

b. algebraic expressions					*		CST TS S
5. Divides							
a. algebraic expressions by a monomial				*			
b a polynomial by a binomial (with or without a remainder)					*		CST
							S
c. a polynomial by another polynomial (with or without a remainder)					*		CST TS S
6. Factors polynomials by							
a. findingthe common factor				*			
 factoring by grouping (polynomials including decomposable second-degree trinomials) 					*		CST TS S
c. completing the square (factoring and switching from one type of notation to another)					*	*	CST TS S
d. using formulas for trinomials of the form $ax^2 + bx + c$:							CST
$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$ and $x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$					*	*	TS S
e. substituting second-degree algebraic identities (perfect square trinomial and					*		CST TS
difference of two squares)					*		S
 Manipulates rational expressions Note : Rational expressions (algebraic fractions) are part of the algebraic expressions to be 							CST
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
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)		→	*				
b. an inequality				*			
2. Recognizes or constructs							
a. (relations or formulas)		→	*				
b. inequality relations and first-degree inequalities in one variable				*			
3. (Manipulates relations or formulas (e.g. isolates an element)		→	*				
4. Represents a situation using							
a. a first-degree equation with one unknown		→	*				
b. a first-degree inequality with a variable				*			
5. (Represents)							
a. (an equation using another register (type) of representation, if necessary)		\rightarrow	*				
b an inequality using another register (type) of representation if peoessary				+			

 6. Determines the missing term in an equation (relations between operations) :¹ a + b = □, a + □ = c, □ + b = c, a - b = □, a - □ = c, □ - b = c, a × b = □, a × □ = c, □ × b = c, a ÷ b = □, a ÷ □ = c, □ ÷ b = c 	*						
 Transforms arithmetic equalities and equations to maintain equivalence (properties and rules for transforming equalities) and justifies the steps followed, if necessary 		→	*				
 Transforms inequalities to maintain equivalence (properties and rules for transforming inequalities) and justifies the steps followed, if necessary 				*			
9. Uses different methods to solve first-degree equations with one unknown of the form $ax + b = cx + d$: trial and error, drawings, arithmetic methods (inverse or equivalent operations), algebraic methods (balancing equations or hidden terms)		→	*				
10. Solves first-degree inequalities in one variable				*			
11. Solves the following types of equations or an inequalities in one variable							
 a. second-degree Note : In TS, this is taught over two years using the functional models under study. 					→ ★	*	CST TS
b. exponential, logarithmic or square root, using the properties of exponents,						*	CST
Note : In CST in Secondary V, students use the definitions of logarithm and change of base to solve exponential and logarithmic equations, but they are not required to solve square root equations or study the properties of radicals and logarithms. In TS, this is taught over two					<i>→</i>	*	TS S
years, using the functional models under study.						~	CST
c. rational						*	TS
						*	CST
d. absolute value						+	TS
						×	CST
e. first-degree trigonometric involving a sine, cosine or tangent expression						*	TS S
f. trigonometric that can be expressed as a sine, cosine or tangent function							CST TS
 Solves a second-degree equation in two variables Note : In TS, this is taught over two years, using the functional models under study. 					\rightarrow	*	CST TS
					*		S
13. Validates a solution, with or without technological tools, by substitution		→	*				
14. Solves an inequality graphically and checks the feasible region of a							
a. first-degree inequality in two variables					*	*	CST TS
					*		S
b. second-degree inequality in two variables					_	*	CS
Note : in 15, this is taught over two years using the functional models under study.					*	~	S
15. Interprets solutions or makes decisions, if necessary, depending on the context		→	*				
D. Analyzing situations using systems of equations or inequalities	6	1	2	3	4	5	
1. Determines whether a situation may be translated by a system of							
a. equations				*			
b. inequalities						*	

2. Translates a situation algebraically or graphically using a system of								
a. equations					*			
b. inequalities							*	
3. Solves a system								
a. of first-degree equations in two variables of the form $y = ax + b$ by u tables of values, graphically or algebraically (by comparison), with o without technological tools	using or				*			
 b. of first-degree equations in two variables Note : The student chooses the method. 						*		
 c. composed of a first-degree equation in two variables and a second- equation in two variables 	-degree							CST
Note : In TS, these systems are solved using graphic representations, with or with use of technological tools.	nout the					*	*	S
 of second-degree equations in relation to conics using changing va applicable 	riables, if							CST TS
e. involving various functional models (mostly graphical solutions)				_	_		*	CST TS
								S
4. Solves a system								
a. of first-degree inequalities in two variables							*	
								OOT
b. involving various functional models (mostly graphical solutions)							*	TS S
 b. involving various functional models (mostly graphical solutions) 5. Validates the solution, with or without technological tools 					→	*	*	TS S
 b. involving various functional models (mostly graphical solutions) 5. Validates the solution, with or without technological tools 6. Interprets the solution or makes decisions if necessary, depending on the 	e context				\rightarrow \rightarrow	*	*	TS S
 b. involving various functional models (mostly graphical solutions) 5. Validates the solution, with or without technological tools 6. Interprets the solution or makes decisions if necessary, depending on the E. Linear programming 	e context	6	1	2	\rightarrow \rightarrow 3	* * 4	*	TS S
 b. involving various functional models (mostly graphical solutions) 5. Validates the solution, with or without technological tools 6. Interprets the solution or makes decisions if necessary, depending on the E. Linear programming 1. Analyzes a situation to be optimized mathematizing the situation using a system of first-degree inequalities variables drawing a bounded or unbounded polygon of constraints to represent situation determining the coordinates of the vertices of the bounded polygon (ferregion) Note : h TS, the coordinates of points of intersection may be determined algebraically matrices, or approximated based on a graph. recognizing and defining the function to be optimized 	e context in two the easible y, using	6	1	2	\rightarrow \rightarrow 3	* * 4	* 5	S S

1. Students were not shown this symbolic notation in elementary school. They did learn, however, to determine the value of a missing term, among other things, in situations that call for additive or multiplicative structures, within the limits of the elementary-level Mathematics program.

For use during the 2021-2022 school year only, in the context of the pandemic

Algebra

Understanding dependency relationships

	Understanding dependency relationships							
\rightarrow	Student constructs knowledge with teacher guidance.	V		Sec	cond	lary		
*	Student applies knowledge by the end of the school year.	entar				-		
	Student reinvests knowledge.	Elem	Cy O	cle ne	(Cycle Two	9	
Α.	Relations, functions and inverses	6	1	2	3	4	5	
1.	dentifies patterns in various situations and in various forms							
2. /	Analyzes situations using different registers (types) of representation	\rightarrow	\rightarrow	*				
3. I	Represents a situation generally using a graph		\rightarrow	*				
4. (Chooses the dependent variable and the independent variable				*			
5. I	Recognizes relations, functions and inverses				*			
6. I	Describes, in the functions under study, the role of							
	a. multiplicative parameters					*		(
	b. additive parameters					*	*	(
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.						*	
В.	Analyzing situations using real functions ¹	6	1	2	3	4	5	Γ
1. 2. 3. 4. 5. 6. 7. 8. (9.	Note : Statements 1 to 9 apply to the functions listed below. Models a situation verbally, algebraically, graphically, using a table of values or a s 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 changin Describes the properties of real functions: domain, range, interval within which the f decreasing, sign, extrema, x-intercept and y-intercept Note : In Secondary III, students are informally introduced to the study of properties, always in relation use a graphical representation to describe the context. Determines values or data by solving equations and inequalities interpolates and extrapolates data, if applicable Compares situations or graphical representations Makes decisions, if necessary, depending on the context	catte	eir va ion is	alue, s incl t. In C	if ne reasi :ST, s	cess ing o tuden	ary r ts	
	a. Polynomial functions of degree 0 or 1				*			

b. Second-degree polynomial functions				
i. $f(x) = ax^2$			*	
			_	
ii $f(x) = (hx)^2$ or $f(x) = a(hx)^2$			+	
1. 1(x) = (bx) (1,x) = d(bx)			<u></u>	
iii $f(x) = ax^2 + bx + c$ $f(x) = a(b(x - b))^2 + k$ $f(x) = a(x - x_1)(x - x_2)$				+
$\prod_{n=1}^{\infty} A_n = a_n + b_n + b_$			*	~
c. Square root functions				
i. $f(x) = a\sqrt{bx}$				
Note : This function is introduced in connection with the second-degree function as inverse (relation expressed as two square root functions).	5		*	_
		+		
ii. $f(x) = a\sqrt{b(x-h)} + k$				*
d Rational functions		_		×
u. Rational functions $k = k k [$				
i. $f(x) = \frac{K}{x}$ or $xy = K, K = \mathbb{Q}^+$		*		
ii $f(x) = a\left(\frac{1}{2}\right) + k$ and $f(x) = \frac{ax+b}{2}$				+
$\lim_{x \to \infty} f(x) = a \left(b(x-h) \right)^{+K} \lim_{x \to \infty} f(x) = cx + d$				*
e. Exponential functions				
			*	
i. $f(x) = ac^x$				
ii. $f(x) = ac^{bx}$		+		
Note : In CST, students are able to manipulate this type of function, but are not			*	
	_	-		-
iii. $f(x) = acb(x - h) + k$ Note: The study of these functions should focus on bases 2, 10 and				*
				*
f. Logarithmic functions		 		
ii. $f(x) = a \log_c bx$			+	
NOTE : This function is introduced in connection with exponential functions (as an inverse).			_	
iii. $f(x) = a \log_C b(x - h) + k$				
Note : The study of these functions should focus on bases 2, 10 and e.				*
a Piecewise functions			*	
Note : In Secondary III, students are introduced to this type of function informally.		\rightarrow	*	+
				×
h. Absolute value functions : $T(X) = a b(X - h) + K$ Note : In TS, this function is treated mainly as a necewise function				_
	_	+-		*
i. Step functions			*	
j. Greatest integer functions		 		
			+	
1. t(x) = a[bx]			×	
ii. $f(x) = a[b(x - h)] + k$				*

k. Functions			
i. Modelling periodic occurences (e.g. natural phenomena such as tides	*		CST
or sound, medical or electrical prenomena)	*		TS
are not required to determine the rule.		\star	S
ii. sinusoidal : $f(x) = a \sin b(x - h) + k$.			CST
$f(x) = a \cos b(x - h) + k$		*	TS
	-	×	CST
iii. tangent : $f(x) = a \tan b(x - h) + k$		*	TS
		*	S

1. Functions are introduced using contexts adapted to Secondary III and the various options, with or without the use of technological tools.

Probability

By acquiring probabilistic reasoning skills, students avoid the confusion between probability and proportion and demystify certain false preconceptions about odds or chance, such as the bias associated with equiprobability, availability and representativeness. This prepares them to exercise their critical judgment in various situations.

In elementary school, students conducted experiments related to chance. They made qualitative predictions about outcomes using concepts related to outcome (certainty, possibility and impossibility) and the probability that an event will occur (more likely, just as likely and less likely). They listed the outcomes of a random experiment using tables or tree diagrams and compared the actual outcomes with theoretical probabilities.

In Secondary Cycle One, students go from using subjective, often arbitrary, reasoning to reasoning based on various calculations. They further develop the concept of probability of an event—the cornerstone in calculating probabilities—and are introduced to the language of sets. They learn to enumerate possibilities using different registers (types) of representation, to calculate probabilities and to compare experimental and theoretical probabilities. With this knowledge and skills, students are able to make predictions and informed decisions in various types of situations.

In Secondary Cycle Two, students continue to build on what they learned in Cycle One. They use the results of combinatorial analysis (permutations, arrangements and combinations) and add the ability to calculate probabilities in certain measurement contexts to their repertoire of knowledge and skills. Depending on the option, students learn to distinguish between subjective probabilities and experimental or theoretical probabilities. They interpret or distinguish between various relationships (e.g. the probability of an event and the *odds for* or the *odds against*). They use the concept of mathematical expectation to determine whether a game is fair or the possibility of a gain or a loss. Lastly, they analyze situations and make decisions based on conditional probability.

The following tables present the learning content associated with probability. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

	Understanding data from random experiments						
÷	Student constructs knowledge with teacher guidance.	ary		Sec	ond	ary	
*	Student applies knowledge by the end of the school year. Student reinvests knowledge.	Element	Cy O	<mark>cle</mark> ne	C	Cycle Two	•
A.	Processing data from random experiments	6	1	2	3	4	5
1.	Simulates random experiments with or without the use of technological tools	*					
2.	Experiments with activities involving chance, using various objects (e.g. spinners, rectangular prisms, glasses, marbles, thumb tacks, 6-, 8- or 12-sided dice)	*					
3.	In activities involving chance						
	a. recognizes variability in possible outcomes (uncertainty)	*					
	 recognizes equiprobability (e.g. quantity of objects, symmetry of an object such as a cube) 	*					
	 becomes aware of the independence of events (e.g. rolling dice, tossing a coin, drawing lots) 	*					
4.	Uses tables or diagrams to collect and display the outcomes of an experiment	*					
5.	Compares the outcomes of a random experiment with known theoretical probabilities	*					
6.	Distinguishes between prediction and outcome	*					
7.	Conducts or simulates random experiments involving one or more steps (with or without replacement, with or without order))	*			
0							
8.	identifies the type of random variable: discrete of continuous				*		_

	Enumerates the possible outcomes of a random experiment using							L
								(
	a. tables, tree diagram	*						
	b. networks, tables, diagrams, Venn diagrams							(
	Note : In developing their probabilistic thinking skills, students are introduced to the language of		\rightarrow	*				
	sets, which is considered to be a comprehension and communication tool.							
	c. geometric ligures				×			
10.	Defines the sample space of a random experiment		\rightarrow	*				
11.	Recognizes certain, probable, impossible, simple, complementary, compatible,		\rightarrow	+				۲
	incompatible, dependent, independents events		-	^				1
	D'ation de la transmission de la construction de la						\star	
12.	between dependent and independent events					*		
	Lloss fractions, desirals or percentages to quantify a probability							
13.	Uses fractions, decimals of percentages to quantify a probability	π						-
14.	Recognizes that a probability is always between 0 and 1	*				,		
15.	Predicts qualitatively an outcome or several events using a probability line, among o	other	thin	gs				
	a. certain, possible or impossible outcome	*						
	b. more likely, just as likely, less likely event	*						
16.	Uses factorial notation, if necessary							-
	Note : This notation may be introduced in CST.					*		-
				-			+	
17.	Recognizes, depending on the context, different types of probabilities:					*	~	1
	experimental, theoretical, subjective							-
18	Defines or interprets the concept of odds/chance (odds for and odds against)						*	
10.	(e.g. makes connections between odds and probabilities)					*		_
		-	<u> </u>	-	<u> </u>		+	
19.	Defines or interprets the concept of mathematical expectation (e.g. makes					+	×	1
	connections between mathematical expectation and weighted mean)					_		1
в.	Analyzing probability situations	6	1	2	3	4	5	ſ
1	Represents an event using different registers (types of representation))	*						
								ſ
2.	Compares qualitatively the theoretical or experimental probability of an event occurring	*						ſ
	Distinguishes between theoretical and experimental probability		\rightarrow	*				1
3.								
3.								þ

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. Image: Secondary Cycle Two. 6. Associates the type of probability to a situation: experimental, theoretical, subjective Image: Secondary Cycle Two. Image: Secondary Cycle Two. 7. Calculates probabilities, including geometric probabilities, in measurement contexts Image: Secondary Cycle Two. Image: Secondary Cycle Two. 8. Calculates conditional probabilities Image: Secondary Cycle Two. Image: Secondary Cycle Two. Image: Secondary Cycle Two. 9. Interprets probabilities and makes appropriate decisions Image: Secondary Cycle Two. Image: Secondary Cycle Two. Image: Secondary Cycle Two. 10. Chooses and applies the concept of odds/chance (odds for and odds against) or probability, depending on the context Image: Secondary Cycle Two. Image: Secondary Cycle Two. 11. Determines the odds for or odds against Image: Secondary Cycle Two. Image: Secondary Cycle Two. Image: Secondary Cycle Two. 13. Calculates mathematical expectation Image: Secondary Cycle Two. Image: Secondary Cycle Two. Image: Secondary Cycle Two. Image: Secondary Cycle Two. 14. Modifies, if necessary, the parameters of a situation in order to make it fair, attain an objective or optimize a gain or loss Image: Secondary Cycle Two. Image: Secondary Cycle T	5.	Calculates the probability of outcomes of random experiments related to situations involving arrangements, permutations or combinations						CST
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15. Interprets the resulting mathematical expectation and makes appropriate decisions	14.	an objective or optimize a gain or loss				*		15
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								S

Statistics

Statistics, which is used to gather, process and analyze data regarding a population,¹ is a valuable decision-making tool in many fields. This branch of mathematics is based on concepts and processes related to probability, particularly as regards sampling.

In elementary school, students were introduced to descriptive statistics, which allowed them to summarize raw data in a clear and reliable way. They conducted surveys, i.e. they learned how to formulate questions, gather data and organize it using tables, and interpreted and displayed data using bar graphs, pictographs and broken-line graphs. They also obtained relevant information using circle graphs, and calculated and interpreted the arithmetic mean of a distribution.

In Secondary Cycle One, students carry out studies using sample surveys and censuses. They acquire the tools they need to process the data they may or may not have gathered and extract information from these data. They learn about circle graphs as a possible method of data representation. They choose the graph(s) that will best illustrate a situation. They learn to highlight information such as minimum value, maximum value, range and mean and look for potential sources of bias.

In Secondary Cycle Two, descriptive statistics is used to introduce students to inferences. The situations dealt with allow students to gather, organize and represent data using the most appropriate graph, and determine certain statistical measures such as measures of central tendency, of position and of dispersion. They interpret data by observing their distribution (type, range, centre, groups), and check whether the distribution includes outliers that could influence certain measures or conclusions. They compare distributions, using appropriate measures of central tendency and of dispersion. They learn how to interpret a correlation qualitatively, using an approximate value of the correlation coefficient or quantitavely, by calculating its exact value using technological tools, if necessary.

The following tables present the learning content associated with statistics. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

Analyzing and making decisions about one- or two-variable d using statistical tools	istri	ibuti	ions	5,			
Student constructs knowledge with teacher guidance.	tary		Sec	cond	lary		
Student applies knowledge by the end of the school year. Student reinvests knowledge.	Elemen	Cy Oi	<mark>cle</mark> ne		Cycle Two	9	
A. One-variable distributions	6	1	2	3	4	5	
1. Conducts a survey or a census							
a. Formulates questions for a survey Note : The questions become more refined over the years.	*						CST TS S
b. Chooses a sampling method :							
i. simple random, systematic		\rightarrow	*				
ii. stratified, cluster				*			CST TS S
c. Chooses a representative sample		\rightarrow	*				
 Collects, describes and organizes data (classifies or categorizes) using tables 	*						CST TS S
 Recognizes possible sources of bias Note : In CST in Secondary IV, students learn to correct the source of bias, if applicable. 		\rightarrow	*				
3. Interprets data presented in a table or a bar graph, a pictograph, a broken-line graph or a circle graph	*						

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							
6.	Organizes and presents data using							
	a. a table, a bar graph, a pictograph and a broken-line graph	*						
	b. a table presenting variables or frequencies, or using a circular graph		→	*				
	c. a table of condensed data or data grouped into classes, a histogram, or box-and-whisker plot				*			CST TS S
	d. a stem-and-leaf diagram					*		CST TS S
7.	Compares one-variable distributions		→	*				
8.	Understands and calculates the arithmetic mean	*						
9.	Describes the concept of arithmetic mean (levelling or balance point)		→	*				
10.	Calculates and interprets an arithmetic mean Note : In Secondary Cycle One, the arithmetic mean is calculated using positive or negative numbers written in decimal notation or using positive numbers written in fractional notation.		<mark>→</mark>	*				
11.	Determines and interprets							
	a. measures of central tendency: mode, median, weighted mean				*			
	b. measures of dispersion :							
	i. range		\rightarrow	*				
	ii. range of each part of a box-and whisker plot, interquartile range				*			
	iii. mean deviation					*		CST TS S
	iv. standard deviation					*		CST TS S
	c. measures of position :							
	i. minimum, maximum		\rightarrow	*				
	ii. percentile					*		CST
	Note : Percentile is determined using a sufficient number of data. Students can also determine corresponding data from a percentile.							S S
12.	Chooses the appropriate statistical measures for a given situation		→	*				CST TS S
В.	Two-variable distributions	6	1	2	3	4	5	
1.	Compares experimental and theoretical data Note : In Secondary III, the study of linear and rational functions is introduced through the use of scatter plots.				*			
2.	Represents data using a scatter plot or a double-entry (two-variable) distribution table					*		

3.	Associates the most appropriate functional model with a scatter plot :			
		*		CST
	a. first-degree polynomial function	*		TS
		*		S
	h functions under study			CST
	D. Turictions under study	*		TS
	Note . In 13, technological tools should be used for models that are not linear.			S
4.	Describes and interprets the relationship between two variables, if any	*		
5.	Gives a qualitative assessment of a linear correlation			
	Note : In TS, qualitative assessment should be used for nonlinear models.	*		
6	Approximates and interprets the linear correlation coefficient			
0.	Note : If pacessary technological tools can be used to determine the value of the correlation	+		
	coefficient for the models under study.			
_		*		CST
1.	Draws a curve associated with the chosen model	*		TS
	Note : In Secondary V, scatter plots are studied with functions.	*		S
8.	Represents a regression line algebraically or graphically			
	Note : In addition to drawing this line freehand, students may use other methods, such as the	*		
	median-median line or the Mayer line method.			
9.	Interpolates or extrapolates values using			
		*		CST
	a. a regression line	*		TS
		*		S
				CST
	b. the functional model best suited to the situation	*		TS
			*	S
		*		CST
10.	Compares two-variable distributions	*		TS
		*		S

1. A population is a set of entities (e.g. individuals of a species, facts) included in a statistical study.

Geometry

As part of their mathematical training, students go from using intuitive, inductive geometry, based on observation, to using deductive geometry. They discover the properties of figures by constructing and observing them. Little by little, they stop relying on measuring and start to use deduction as the basis for their reasoning. By referring to data, initial hypotheses or accepted properties, students prove statements that they believe are true (known as conjectures), which are then used to prove new ones.

In elementary school, students developed their measurement sense¹ by making comparisons and estimates and taking various measurements using conventional and unconventional units of measure. They designed and built measuring instruments and used invented and conventional ones. They calculated direct and indirect measurements.² They also located numbers on an axis and in a Cartesian plane. They constructed and compared different solids, focusing on prisms and pyramids. They learned to recognize the nets of convex polyhedrons and tested Euler's theorem. They described circles and described and classified quadrilaterals and triangles. They observed and produced frieze patterns and tessellations, using reflections and translations. Lastly, they estimated and determined different measurements: lengths, angles, surface areas, volumes, capacities, masses, time and temperature.

In Secondary Cycle One, students construct and manipulate relations or formulas, particularly when calculating the perimeter and area of geometric figures,³ using arithmetic and algebraic concepts and processes. They learn the concept of similar figures, look for unknown figures resulting from a similarity transformation, determine arc measurements and calculate the area of segments, using the concept of proportionality. By studying lines, plane figures and solids, students identify properties and relationships between measurements. Lastly, they are introduced to deductive reason, in which they use different statements (definitions, properties, axioms, previously proven conjectures) to justify the steps in their approach or validate conjectures.

In Secondary Cycle Two, students construct and manipulate relations or formulas when calculating the area and volume of solids and determining unknown measurements in right triangles or other triangles, using metric and trigonometric relations. If necessary, they convert various units of measure. They refine their understanding of congruence or similarity, particularly by studying the conditions that allow them to conclude that triangles are congruent or similar. They analyze and optimize situations using the concept of equivalent geometric figures. The concept of vectors is introduced and builds on what students have learned about linearity in the previous cycle. In these various contexts, students use different types of reasoning, particularly deductive reasoning, to validate conjectures.

The following tables present the learning content associated with geometry. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

- Spatial sense and analyzing situations involving geometric figures
- Analyzing situations involving measurements

1. Unlike in elementary school, in secondary school, measurement is part of geometry.

- Calculating a perimeter or area and graduating a ruler are examples of direct measurements. Reading a scale drawing, making a scale drawing, measuring an area of a figure by decomposing it, calculating the thickness of a sheet of paper based on the thickness of several sheets are examples of indirect measurements.
- 3. In a geometric space of a given dimension (0, 1, 2 or 3), a geometric figure is a set of points representing a geometric object such as a point, line, curve, polygon or polyhedron.

Geometry

Spatial sense and analyzing situations involving geometric figures

	Spatial sense and analyzing situations involving geometri	c fig	gure	S			
→ *	Student constructs knowledge with teacher guidance. Student applies knowledge by the end of the school year.	entary		lary			
	Student reinvests knowledge.	Eleme	Cy	<mark>cle</mark> ne	(Cycle Two	9
Α.	Plane figures	6	1	2	3	4	5
1.	Describes convex and nonconvex polygons						
2.	Describes and classifies quadrilaterals						
3.	Describes and classifies triangles	*					
4.	Describes circles: radius, diameter, circumference, central angle	*					
5.	Recognizes and names regular convex polygons		*				
6.	Decomposes plane figures into circles (sectors), triangles or quadrilaterals		→	*			
7.	Describes circles and sectors		→	*			
8.	Recognizes and draws main segments and lines						
	a. diagonal, altitude, median, perpendicular bisector, bisector, apothem, radius, diameter, chord		→	*			
	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.		÷	*			
10.	Justifies statements using definitions or properties ¹ of plane figures		→	*			
В.	Solids	6	1	2	3	4	5
1.	Matches the net of a convex polyhedron to the corresponding convex polyhedron	*					
2.	Determines the possible nets of a solid		→	*			
3.	Names the solid corresponding to a net		→	*			
4.	Describes solids :						
	a. vertex, edge, base, face	*					
	b. altitude, apothem, lateral face		→	*			
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.	*					
6.	Recognizes solids that can be split into						
	a. (right prisms, right cylinders, right pyramids)		\rightarrow	*			

ST S

b. right cones and spheres				*			
 7. Represents three-dimensional figures in the plane, using different procedures : net 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 Euclidian plane ²	6	1	2	3	4	5	
 Observes and produces frieze patterns and tessellations using reflections and translations 	*						
 Identifies properties and invariants resulting from geometric constructions and transformations 		\rightarrow	*				
3. Identifies congruence (translation, rotation and reflection) between two figures		\rightarrow	*				
4. Constructs the image of a figure under a translation, rotation and reflection		\rightarrow	*				
5. Recognizes dilatation with a positive scale factor		\rightarrow	*				
6. Constructs the image of a figure under a dilatation with a positive scale factor		\rightarrow	*				
D. Congruent, similar or equivalent figures	6	1	2	3	4	5	
1. Identifies congruent figures in frieze patterns and tessellations	*						
		$ \rightarrow $	+				
2. Recognizes congruent or similar figures			~				
 Recognizes congruent or similar figures Recognizes the geometric transformation(s) linking a figure and its image 		, →	*				
 Recognizes congruent or similar figures) Recognizes the geometric transformation(s) linking a figure and its image Determines the properties and invariants of congruent or similar figures) 		→ → →	*				
 Recognizes congruent or similar figures) Recognizes the geometric transformation(s) linking a figure and its image Determines the properties and invariants of congruent or similar figures) Determines the minimum conditions required to conclude that triangles are congruent or similar Note : See Avenues of Exploration in Appendix E of the Secondary Cycle Two Mathematics program. 		→ →	*		*		
 Recognizes congruent or similar figures Recognizes the geometric transformation(s) linking a figure and its image Determines the properties and invariants of congruent or similar figures Determines the minimum conditions required to conclude that triangles are congruent or similar Note : See Avenues of Exploration in Appendix E of the Secondary Cycle Two Mathematics program. Demonstrates the congruence or similarity between triangles or finds unknown measurements using minimum conditions 		 → → → 	*		*		
 Recognizes congruent or similar figures) Recognizes the geometric transformation(s) linking a figure and its image Determines the properties and invariants of congruent or similar figures) Determines the minimum conditions required to conclude that triangles are congruent or similar Note : See Avenues of Exploration in Appendix E of the Secondary Cycle Two Mathematics program. Demonstrates the congruence or similarity between triangles or finds unknown measurements using minimum conditions Recognizes equivalent figures (plane figures or solids) 		 → → → 	*		*	*	CS

1. In all statements involving justification, the properties used were identified through exploration or have been proven.

2. Geometric transformations in the Cartesian plane are not covered in Secondary Cycle One.

Geometry

Analyzing situations involving measurements

Analyzing situations involving measurements ¹						
Student constructs knowledge with teacher guidance.	tary		Sec	cond	lary	
Transformation applies knowledge by the end of the school year.	men	Су	cle		Cvcl	e
Student reinvests knowledge.	Ĕ	0	ne		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						
3. Establishes relationships between units of time: second, minute, hour, day, daily cycle, weekly cycle, yearly cycle	*					
 Distinguishes between duration and position in time Note : This includes the concept of negative time, where the start time <i>t</i> = 0 is arbitrarily chosen. 		\rightarrow	*			
C. Angles	6	1	2	3	4	5
1. Compares angles: acute angle, right angle, obtuse angle						
2. Estimates and determines the degree measure of angles	*					
 Describes the characteristics of different types of angles: complementary, supplementary, adjacent, vertically opposite, alternate interior, alternate exterior and corresponding 		→	*			
4. Determines measures of angles using the properties of the following angles: complementary, supplementary, vertically opposite, alternate interior, alternate exterior and corresponding		→	*			
5. Finds unknown measurements using the properties of figures and relations						
a. measures of angles in a triangle		*				
b. degree measures of central angles and arcs		→	*			
6. Defines the concept of radian						*
7. Determines the correspondence between degrees and radians						*
8. Justifies statements using definitions or properties associated with angles and their measures		→	*			×

D. Length	6	1	2	3	4	5	
1. Chooses the appropriate unit of length for the context							
2. Estimates and measures the dimensions of an object using conventional units: millimetre, centimetre, decimetre, metre and kilometre	*						
3. Establishes relationships between							
a. units of length: millimetre, centimetre, decimetre, metre and kilometre	*						
b. measures of length of the international system (SI)		*					
4. Constructs relations that can be used to calculate the perimeter or circumference of figures		→	*				
5. (Finds the following unknown measurements, using properties of figures and relation	ons						
a. perimeter of plane figures							
b. a segment in a plane figure, circumference, radius, diameter, length of an arc, a segment resulting from an isometry or a similarity transformation		<mark>→</mark>	*				
c. segments in a solid resulting from an isometry or a similarity transformation				*			
d. segments or perimeters resulting from equivalent figures						*	C
					*		
6. (Justifies statements concerning measures of length)		→	*				
E. Area	6	1	2	3	4	5	
1. Chooses the appropriate unit of area for the context							
 Estimates and measures surface areas using conventional units: square centimetre, square decimetre, square metre 	*						
3. (Establishes relationships between SI units of area)		→	*				
4. Constructs relations that can be used to calculate the area of plane figures:							
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.	0	→	*				
5. Uses relations that can be used to calculate the area of a right cone and a sphere				*			
6. Finds unknown measurements, using properties of figures and relations							
a. area of circles and sectors		→	*				
 b. area of figures that can be split into circles (sectors), triangles or quadrilaterals 		→	*				
c. (lateral or total area of right prisms, right cylinders and right pyramids)		→	*				
 d. (lateral or total area of solids that can be split into right prisms, right cylinders or right pyramids) 		-	*				
e. area of figures resulting from an isometry		→	*				
 f. area of figures resulting from a similarity transformation Note : In similar plane figures, the ratio of the areas is equal to the square of the similarity ratio. 			\rightarrow	*			
g. area of a sphere, lateral or total area of right cones and decomposable solids				*			
b area of aquivalent figures						*	C
n. area or equivalent ligures					*	*	
7. Justifies statements concerning measures of area		\rightarrow	*				

F.	Volume	6	1	2	3	4	5	
1.	Chooses the appropriate unit of volume for the context							
2.	Estimates and measures volume or capacity using conventional units: cubic centimetre, cubic decimetre, cubic metre, millilitre, litre	*						
3.	Establishes relationships between SI units of volume				*			
4.	Establishes relationships between							
	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							
	 volume of right prisms, right cylinders, right pyramids, right cones and spheres 				*			
	 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 Note : In similar solids, the ratio of the volumes is equal to the cube of the similarity ratio. 				*			
	d volume of equivalent colide						*	CST
						*	*	TS S
7.	7. Justifies statements concerning measures of volume or capacity				*			
G.	Metric or trigonometric relations	6	1	2	3	4	5	
G . 1.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures	6	1 →	2 →	3 →	4 →	5 →	
G . 1. 2.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations	6	1 →	2 →	3 →	4 →	5 →	
G. 1. 2.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations a. in a right triangle rectangle using	6	1 →	2 →	3 →	4 →	5 →	
G. 1. 2.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations a. in a right triangle rectangle using i. Pythagorean relation	6	1 →	2 →	3 →	4 →	5 →	
G. 1. 2.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations a. in a right triangle rectangle using i. Pythagorean relation ii. the following metric relations - The length of a leg of a right triangle is the geometric mean between the length of its projection on the hypotenuse and the length of the hypotenuse. - The length of the altitude to the hypotenuse of a right triangle is the geometric mean between the lengths of the segments of the hypotenuse. - The product of the lengths of the legs of a right triangle is equal to the product of the length of the hypotenuse and the length of the hypotenuse.	6	1	2	3 →	4 →	5 →	
G.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations a. in a right triangle rectangle using i. Pythagorean relation ii. the following metric relations - The length of a leg of a right triangle is the geometric mean between the length of its projection on the hypotenuse and the length of the hypotenuse. - The length of the altitude to the hypotenuse of a right triangle is the geometric mean between the lengths of the segments of the hypotenuse. - The product of the lengths of the legs of a right triangle is equal to the product of the length of the hypotenuse and the length of the hypotenuse. - The product of the length of the hypotenuse and the length of the length of the hypotenuse. - The product of the lengths of the legs of a right triangle is equal to the product of the length of the hypotenuse and the length of the altitude to the hypotenuse. iii. trigonometric ratios: sine, cosine, tangent Note : In TS and S, students also use cosecant, secant and cotangent in Secondary V.	6		2	3 →	4 →	5 →	
G.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations a. in a right triangle rectangle using i. Pythagorean relation ii. the following metric relations - The length of a leg of a right triangle is the geometric mean between the length of its projection on the hypotenuse and the length of the hypotenuse. - The length of the altitude to the hypotenuse of a right triangle is the geometric mean between the lengths of the segments of the hypotenuse. - The product of the lengths of the legs of a right triangle is equal to the product of the length of the hypotenuse and the length of the hypotenuse. iii. trigonometric ratios: sine, cosine, tangent Note : In TS and S, students also use cosecant, secant and cotangent in Secondary V. b. in any triangle using	6		2	3 →	4 →	5	
G.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations a. in a right triangle rectangle using i. Pythagorean relation ii. the following metric relations - The length of a leg of a right triangle is the geometric mean between the length of its projection on the hypotenuse and the length of the hypotenuse. - The length of the altitude to the hypotenuse of a right triangle is the geometric mean between the lengths of the segments of the hypotenuse. - The product of the lengths of the legs of a right triangle is equal to the product of the length of the hypotenuse and the length of the altitude to the hypotenuse and the length of the altitude to the hypotenuse. iii. trigonometric ratios: sine, cosine, tangent Note : h TS and S, students also use cosecant, secant and cotangent in Secondary V. b. in any triangle using i. sine law	6		2	3 →	4 →	5 →	CST
G.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations a. in a right triangle rectangle using i. Pythagorean relation ii. the following metric relations - The length of a leg of a right triangle is the geometric mean between the length of its projection on the hypotenuse and the length of the hypotenuse. - The length of the altitude to the hypotenuse of a right triangle is the geometric mean between the lengths of the segments of the hypotenuse. - The product of the lengths of the legs of a right triangle is equal to the product of the length of the hypotenuse and the length of the altitude to the hypotenuse and the length of the altitude to the hypotenuse. iii. trigonometric ratios: sine, cosine, tangent Note : h TS and S, students also use cosecant, secant and cotangent in Secondary V. b. in any triangle using i. sine law	6		2	3 →	4 → ★ ★	5 →	CSI TS S
G.	Metric or trigonometric relations Determines, through exploration or deduction, different metric relations associated with plane figures Finds unknown measurements in various situations a. in a right triangle rectangle using i. Pythagorean relation ii. the following metric relations - The length of a leg of a right triangle is the geometric mean between the length of its projection on the hypotenuse and the length of the hypotenuse. - The length of the altitude to the hypotenuse of a right triangle is the geometric mean between the lengths of the segments of the hypotenuse. - The product of the lengths of the legs of a right triangle is equal to the product of the length of the hypotenuse and the length of the altitude to the hypotenuse and the length of the altitude to the hypotenuse. iii. trigonometric ratios: sine, cosine, tangent Note: In TS and S, students also use cosecant, secant and cotangent in Secondary V. b. in any triangle using i. sine law ii. cosine law	6		2	3 →	4 →	5 →	CST TS S CST TS

					\star		CST
Note : In TS and S this formula may be provided and used if necessary							TS
							S
 c. in a circle: measure of arcs, chords, inscribed angles, interior angles and exterior angles 						*	CST TS
Note : See Avenues of Exploration, Secondary Cycle Two Mathematics program, p. 127.							S
3. Calculates the area of a triangle given the measure of an angle and the lengths of two sides or given the measures of two angles and the length of one side					*		
4. Proves trigonometric identities by using algebraic properties, definitions (sine,							CST
properties of periodicity and symmetry						\star	тs
Note : Formulas for finding the sum or difference of angles are compulsory in S only.						\star	S
5. Justifies statements concerning							
a. Pythagorean relation				*			
b. metric or trigonometric relations					*		
H. Vectors in the Cartesian or Euclidian plane	6	1	2	3	4	5	
1. Defines a vector: magnitude (length or norm), direction, sense							CST
Note : In Secondary Cycle One, vectors are used in translations.						*	TS
		<u> </u>	<u> </u>			*	C ST
2. Represents a vector graphically (arrow in a plane or pair in a Cartesian plane)						+	TS
Note : In TS, students may use a matrix with geometric transformations.					-	*	S
							CST
3. Identifies properties of vectors						*	TS
4. Derferme en erstiens en vesters						*	5
4. Performs operations on vectors Note : In TS, operations on vectors are performed in context.							
							CST
a. determination of the resultant or projection of a vector						*	TS
						*	S
							CST
b. addition and subtraction of vectors						*	TS
						*	S
a multiplication of a vector by a scalar						+	CSI
					-	*	S
						~	CST
d. scalar product of two vectors						*	TS
						\star	S
							CST
e. linear combination of vectors							IS
						*	CST
f application of Chasles relation					-		TS
						*	S
							CST
5. Justifies statements using properties associated with vectors							TS
						*	S
6. Analyzes and models situations using vectors (e.g. displacements, forces, speeds						+	TS
or velocities)						A	
						*	S

1. Depending on the context, measurement prefixes (e.g. nano, micro, milli, deca, kilo, mega, giga) are introduced.

Mathematics Analytic Geometry

Analytic geometry provides a link between geometry and algebra. It allows students to represent geometric objects using equations and inequalities. Students therefore work on representations in a Cartesian plane.

In Secondary Cycle One, students perfect their ability to locate points in the Cartesian plane, using the types of numbers under study. They learn to represent a situation generally, using a graph.

In Secondary Cycle Two, students learn to model and analyze situations using a Cartesian reference point. They calculate distances, determine the coordinates of a point of division and study geometric loci. Depending on the option, they use coordinates to perform geometric transformations and determine results in a standard unit circle.

The following tables present the learning content associated with analytic geometry. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

 Student constructs knowledge with teacher guidance. Student applies knowledge by the end of the school year. Student reinvests knowledge. Locating Locates objects/numbers on an axis, based on the types of numbers studied Note: In Secondary Cycle One, students locate positive or negative numbers written in decimal or fractional notation. Locates points in a Cartesian plane, based on the types of numbers studied (x- and y-coordinates of a point) Straight lines and half-planes Uses the concept of change to a. calculate the distance between two points 	9 ¥ ¥ 9 Elementary	Cy 0 1 → 1	Ser (cle) ne 2 * 2	cond (3	lary Cyclo Two 4	5
 Student applies knowledge by the end of the school year. Student reinvests knowledge. A. Locating Locates objects/numbers on an axis, based on the types of numbers studied Note : In Secondary Cycle One, students locate positive or negative numbers written in decimal or fractional notation. Locates points in a Cartesian plane, based on the types of numbers studied (x- and y-coordinates of a point) B. Straight lines and half-planes Uses the concept of change to a. calculate the distance between two points 	9 ¥ 49 Elementar	Cy 0 1 → 1	rcle ne 2 ★	3	Cycle Two 4	5
 Student reinvests knowledge. A. Locating 1. Locates objects/numbers on an axis, based on the types of numbers studied Note : In Secondary Cycle One, students locate positive or negative numbers written in decimal or fractional notation. 2. Locates points in a Cartesian plane, based on the types of numbers studied (x- and y-coordinates of a point) B. Straight lines and half-planes 1. Uses the concept of change to a. calculate the distance between two points 	6 Eem	Cy ○ 1 → 1	cle ne 2 *	3	Cycle Two 4	5
 A. Locating 1. Locates objects/numbers on an axis, based on the types of numbers studied Note : In Secondary Cycle One, students locate positive or negative numbers written in decimal or fractional notation. 2. Locates points in a Cartesian plane, based on the types of numbers studied (x- and y-coordinates of a point) B. Straight lines and half-planes 1. Uses the concept of change to a. calculate the distance between two points 	6 ★ ★ 6	1 → → 1	2 * 2	3	4	5
 Locates objects/numbers on an axis, based on the types of numbers studied Note : In Secondary Cycle One, students locate positive or negative numbers written in decimal or fractional notation. Locates points in a Cartesian plane, based on the types of numbers studied (x- and y-coordinates of a point) B. Straight lines and half-planes Uses the concept of change to calculate the distance between two points 	*	→ → 1	*	3	4	5
 2. Locates points in a Cartesian plane, based on the types of numbers studied (x-and y-coordinates of a point) B. Straight lines and half-planes 1. Uses the concept of change to a. calculate the distance between two points 	*	<mark>→</mark> 1	* 2	3	4	5
 B. Straight lines and half-planes 1. Uses the concept of change to a. calculate the distance between two points 	6	1	2	3	4	5
Uses the concept of change to a. calculate the distance between two points			-			
a. calculate the distance between two points						
Note : In Secondary III, students are introduced to the concept of distance between two points while studying the Pythagorean relation. In Secondary IV, the distance between two parallel lines or from a point to a line or segment is studied using concepts and processes associated with distance and equations systems.				→	*	
b. determine the coordinates of a point of division using a given ratio (including the coordinates of a midpoint)			\square		*	
Note : In S, students can also determine the coordinates of a point of division using the product of a vector and a scalar.					*	+
 c. calculate and interpret a slope Note : In Secondary III, students are introduced informally to the concept of slope while studying the rate of change of functions (degree 0 and 1). 				→	*	~
2. Determines the relative position of two straight lines using their respective slope (intersecting at one point, perpendicular, non-intersecting parallel or coincident) Note : In Secondary III, students are introduced to the concept of relative position between two lines when comparing the rate of change and graphs of functions (degree 0 and 1). The same is true for solving systems of linear equations in two variables.				÷	*	
3. Models, with or without technological tools, a situation involving			<u> </u>			
a. straight lines: graphically and algebraically						
Note : In Secondary III, students are introduced informally to the concept of lines when they study functions of degree 0 and 1. The different forms of equations of a line (standard, general and symmetric) are explored in the various options. The symmetric form of the equation of a line is not covered in CST; it is optional in TS and compulsory in S. The general form of the equation of a line is optional in CST.				→	*	
b. a half-plane: graphically and algebraically					+	*
				<u> </u>	*	
					×	

5. Determines the equation of a line parallel or perpendicular to another Note : The general form of the equation of a line is optional in CST. Image: Comparison of the equation of a line is optional in CST. Image: Comparison of the equation of a line is optional in CST. Image: Comparison of the equation of a line is optional in CST. Image: Comparison of the equation of a line is optional in CST. Image: Comparison of the equation of a line is optional in CST. Image: Comparison of the equation of the equations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin, scaling (expansions and contractions) Image: Comparison of the equation of the equations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin at transformation with respect to the waxis and y-axis, dilatations centred at the origin, reflections with respect to the waxis and y-axis, dilatations centred at the origin at transformation with respect to the waxis and y-axis, dilatations centred at the origin at transformation. Image: transformation with respect to the waxis and y-axis, dilatations centred at the origin at transformation. Image: transformation with respect to the secular and transformation at transformation at transformation. Image: transformation with respec	4.	Determines the equation of a line using the slope and a point or using two points Note : The general form of the equation of a line is optional in CST.					*		
C. Geometric transformations 6 1 2 3 4 5 1. Identifies, through observation, the characteristics of geometric transformations in the Cartesian plane: translations, rotations centred at the origin, scaling (expansions and contractions) 1	5.	Determines the equation of a line parallel or perpendicular to another Note : The general form of the equation of a line is optional in CST.					*		
1. Identifies, through observation, the characteristics of geometric transformations in the Cartesian plane: translations, rotations centred at the origin, cellections with respect to the x-axis and y-axis, dilatations centred at the origin, scaling (expansions and contractions) Image: Cartesian plane: translations, rotations centred at the origin, scaling (expansions and contractions) 2. Defines algebraically the rule for a geometric transformation. Image: Cartesian plane, the image of a figure using a transformation rule. Image: Cartesian plane, the image of a figure using a transformation rule. Image: Cartesian plane, the image of a figure using a transformation rule. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a figure using a matrix. Image: Cartesian plane, the image of a fi	C.	Geometric transformations	6	1	2	3	4	5	
in the Cartesian plane: translations, rotations centred at the origin, reflections with respect to the x-axis and y-axis, dilatations centred at the origin, scaling (expansions and contractions) 2. Defines algebraically the rule for a geometric transformation Note: In TS, students may also use a matrix to define a geometric transformation rule Note: In TS, students may also use a matrix to define a geometric transformation rule Note: In TS, students also determine the vertices of an image using a matrix. 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. 4. Anticipates the effect of a geometric transformation on a figure 5. D. Geometric loci 6 1 2 3 4 5 7. 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. 3. Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian planes. Net: In S, the study of geometric loci is limited to conics. 3. Analyzes and models situations using conics - describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions - graphing a conic and its internal and external region - validating and interpreting the solution, if necessary - validating and interpreting the solution, if necessary - validating and hyperbola centred at the origin - circle, ellipse and hyperbola resulting from a translation - circle, ellipse and hyperbola resulting from a translation - circle, ellipse and hyperbola resulting from a translation - circle, ellipse and hyperbola resulting from a translation - circle, ellipse and hyperbola resulting systems involving the functional models under study and entals mostly graphical solutions (with or without the use of technological tools). - circle,	1.	Identifies, through observation, the characteristics of geometric transformations							CST
2. Defines algebraically the rule for a geometric transformation		in the Cartesian plane: translations, rotations centred at the origin, reflections with respect to the x-axis and y-axis, dilatations centred at the origin, scaling (expansions and contractions)						*	TS
2. Defines algebraically the rule for a geometric transformation Note : In TS, students may also use a matrix to define a geometric transformation rule 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. 4. Anticipates the effect of a geometric transformation on a figure 5. 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. 2. Analyzes and models situations involving geometric loci involving lines or circles only. In S, the study of geometric loci as include plane loci, i.e. geometric loci involving lines or circles only. In S, the study of geometric loci as include plane loci, i.e. geometric loci involving lines or circles only. In S, the study of geometric loci as oncic. radius, axes, directrix, vertices, foci, asymptotes, regions 2. circle, ellipse and hyperbola centred at the origin 3. Analyzes and models as include plane loci, i.e. geometric loci involving lines or circles only. In S, the study of geometric loci as information 3. Analyzes and models situations using conics 4. circle, ellipse and hyperbola centred at the origin 5. circle, ellipse and hyperbola centred at the origin 5. circle, ellipse and hyperbola centred at the origin 5. d. Determines the coordinates of points of intersection between 5. d. Determines the coordinates of points of intersection between 5. d. a line and a conic 5. dual a conic 5. dual a conic 5. dual a conic 5. dual a conic (Circle and a conic) 5. dual a conic (Circle and a conic) 5. dual a conic 5. dual a co									S
3. Constructs, in the Cartesian plane, the image of a figure using a transformation rule K TS Note in TS, students also determine the vertices of an image using a matrix. K TS Anticipates the effect of a geometric transformation on a figure K TS Describes, represents and constructs geometric loci in the Euclidian and Cartesian planes, with or without technological tools Note : h S, the study of geometric loci is limited to conics. Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian planes Analyzes and models situations using conics describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions	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
Note:: hTS, students also determine the vertices of an image using a matrix. S 4. Anticipates the effect of a geometric transformation on a figure CST 5. D. Geometric loci 6 1 2 3 4 5 7. Describes, represents and constructs geometric loci in the Euclidian and Cartesian planes, with or without technological tools CST S 8. Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian planes CST S 9. Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian planes CST S 9. Analyzes and models situations using conics CST S S 9. Analyzes and models situations using conics CST S 9. Analyzes and models situations using conics CST S 9. Analyzes and models situations using conics S S 9. Analyzes and models situations using conics S S 9. Analyzes and models situations using conic radius, axes, directrix, vertices, foci, asymptotes, regions S 9. Analyzes and models situation of a conic radius internal and external region S 9. Circle, ellipse and hyperbola centred at the origin S 9. circle, ellipse and hyperbola centred at the origin <t< td=""><td>3.</td><td>Constructs, in the Cartesian plane, the image of a figure using a transformation rule</td><td></td><td></td><td></td><td></td><td></td><td>*</td><td>CST TS</td></t<>	3.	Constructs, in the Cartesian plane, the image of a figure using a transformation rule						*	CST TS
4. Anticipates the effect of a geometric transformation on a figure Image: Construct of the second seco	-	Note :In TS, students also determine the vertices of an image using a matrix.							S CST
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 5, the study of geometric loci is limited to conics. 5 6 1 2 3 4 5 2. Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian planes 5 5 3. Analyzes and models situations using conics - describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions - graphing a conic and its internal and external region - constructing the rule of a conic cand its internal and external region - constructing the rule of a conic cand its infernal and external region - validating and interpreting the solution, if necessary 5 b. circle, ellipse and hyperbola centred at the origin 1 5 c. circle, ellipse and hyperbola resulting from a translation 1 5 c. circle, ellipse and hyperbola resulting from a translation 1 5 d. Determines the coordinates of points of intersection between 5 5 a. a line and a conic Wore 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). 5 5 b. two conics (a parabola and a conic) 5 5 5	4.	4. Anticipates the effect of a geometric transformation on a figure						*	TS
D. Geometric loci C + 2 C						3	4	5	S
1. Describes, represents and considurate geometric loci in the Euclidian and Cartesian planes, with or without technological tools 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. 3. Analyzes and models situations using conics - describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions - graphing a conic and its internal and external region - constructing the rule of a conic based on its definition - finding the rule (standard form) of a conic and its internal and external region - validating and interpreting the solution, if necessary a. parabola centred at the origin and resulting from a translation * s b. circle, ellipse and hyperbola centred at the origin a. line and a conic 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). b. two conics (a parabola and a conic)	D.	Describes represents and constructs geometric loci in the Euclidian and					-	.	CST
Note : In S, the study of geometric loci is limited to conics. Image: S 2. Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian planes Image: S 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. Image: S 3. Analyzes and models situations using conics Image: describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions Image: describing the rule of a conic based on its definition Image: describing the rule of a conic based on its definition Image: describing the rule (standard form) of a conic and its internal and external region Image: describing the rule (standard form) of a conic and its internal and external region Image: validating and interpreting the solution, if necessary Image: describing the rule of a conic based on its definition Image: describing the rule of a conic based on its definition Image: validating and interpreting the solution, if necessary Image: describing the rule of a conic based on its definition Image: describing the rule of a conic based on its definition Image: validating and interpreting the solution, if necessary Image: describing the rule of a conic based on its definition Image: describing the rule of a conic based on its definition Image: validating and hyperbola centred at the origin Image: describing the rule of a conic based on its definition Image: describing the rule of	Cartesian planes, with or without technological tools							*	TS
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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. Analyzes and models situations using conics	2.	Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian planes							CSI
3. Analyzes and models situations using conics - describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions - graphing a conic and its internal and external region - constructing the rule of a conic based on its definition - finding the rule of a conic based on its definition - finding the rule of a conic based on its definition - constructing the rule of a conic based on its definition - finding the rule (standard form) of a conic and its internal and external region - validating and interpreting the solution, if necessary - CST a. parabola centred at the origin and resulting from a translation - * S b. circle, ellipse and hyperbola centred at the origin - * S c. circle, ellipse and hyperbola resulting from a translation - * TS c. circle, ellipse and hyperbola resulting from a translation - * S d. Determines the coordinates of points of intersection between - S S a. a line and a conic - * S S b. two conics (a parabola and a conic) - TS S c. two conics (a parabola and a conic) - TS <td colspan="2">Note : In TS, geometric loci also include plane loci, i.e. geometric loci involving lines or circles only.</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>*</td> <td>S</td>	Note : In TS, geometric loci also include plane loci, i.e. geometric loci involving lines or circles only.							*	S
a. parabola centred at the origin and resulting from a translation Image: CST image: C	 3. Analyzes and models situations using conics describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions graphing a conic and its internal and external region constructing the rule of a conic based on its definition finding the rule (standard form) of a conic and its internal and external region validating and interpreting the solution, if necessary 								
b. circle, ellipse and hyperbola centred at the origin b. circle, ellipse and hyperbola resulting from a translation c. circle, ellipse and hyperbola resulting from a translation 4. Determines the coordinates of points of intersection between a. a line and a conic Note : ln 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). b. two conics (a parabola and a conic) b. two conics (a parabola and a conic) b. two conics (a parabola and a conic)		a. parabola centred at the origin and resulting from a translation						*	CST TS S
c. circle, ellipse and hyperbola resulting from a translation Image: Constraint of the coordinates of points of intersection between 4. Determines the coordinates of points of intersection between Image: Constraint of the coordinates of points of intersection between a. a line and a conic Image: Constraint of the coordinates of points of intersection between A. betermines the coordinates of points of intersection between Image: Constraint of the coordinates of points of intersection between a. a line and a conic Image: Constraint of the coordinates of points of with or without the use of technological tools). Image: Constraint of the coordinates of technological tools). b. two conics (a parabola and a conic) Image: Constraint of the coordinates of technological tools). Image: Constraint of the coordinates of technological tools).		b. circle, ellipse and hyperbola centred at the origin						*	CST TS S
4. Determines the coordinates of points of intersection between CST a. a line and a conic CST 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 b. two conics (a parabola and a conic) TS		c. circle, ellipse and hyperbola resulting from a translation						*	CST TS
a. a line and a conic CST 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).	4.	Determines the coordinates of points of intersection between							
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). Image: TS is a study and entails mostly graphical solutions (with or without the use of technological tools). b. two conics (a parabola and a conic) Image: TS is a study and entails mostly graphical solutions (with or without the use of technological tools).	<u> </u>	a, a line and a conic							CST
b. two conics (a parabola and a conic)		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).						* *	TS S
		b. two conics (a parabola and a conic)						*	CST TS S

E. Standard unit circle		1	2	3	4	5	
1. Establishes the relationship between trigonometric ratios and the standard unit							CST
circle (trigonometric ratios and lines)						*	TS
						*	S
 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
							CST
 Analyzes and uses periodicity and symmetry to determine coordinates of points accordinates of points 						*	TS
associated with significant angles in the standard unit circle					4 5	S	
							CST
4. Proves Pythagorean identities						*	TS
						*	S

Discrete Mathematics

Discrete mathematics is a branch of mathematics that focuses mainly on situations involving finite sets and countable objects. Its focus of study involves all areas of mathematics and numerous applications in a variety of fields: transportation, telecommunications, health, programming, etc. This section covers the concepts and processes more directly related to graphs, social choice and matrices.

- <u>Graphs</u>
- Social Choice Theory
- <u>Matrices</u>

Discrete Mathematics

Graphs

In learning about graph theory, students in the *Cultural*, *Social and Technical* option acquire new tools for analyzing situations and are introduced to a different way of reasoning. This theory is used to model and, if necessary, to optimize situations in different branches of mathematics (e.g. tree diagrams in probability, the representation of convex polyhedrons [planar graph]) and in various fields such as social sciences, chemistry, biology or computer science. It can be used to relate various elements associated with task planning, scheduling or inventory management, communication or distribution networks, electric or other types of circuits, incompatibilities (interactions), localizations, strategies, and so on.

To draw a graph for a given situation, students must choose the elements that will be represented by vertices and those that will be represented by edges. The terms associated with graphs are introduced as they arise in the situations presented; however, the point is not to memorize a series of definitions. The properties are also introduced during exploration activities.¹

The following tables present the learning content associated with graphs. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

Introduction to graph theory							
→ Student constructs knowledge with teacher guidance.	> Secondary						
Student applies knowledge by the end of the school year.	nental						
Student reinvests knowledge.	Elen	Cy Oi	cle ne	(Cycl Twc	e)	
A. Concepts associated with graph theory	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
 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

1. See Avenues of Exploration in Appendix E of the Secondary Cycle Two Mathematics program, p. 124.

Discrete Mathematics

Social Choice Theory

Mathematical models are used in social, political and economic situations. Some models are used to ensure the fair distribution of individuals and goods, while other models or voting procedures involve aggregating individual preferences in order to clarify the choices to be made in satisfying as many people as possible (e.g. elections, market surveys, classifications). By using the mathematical concepts and processes already acquired, students in the Cultural, Social and Technical option can compare and analyze the different models associated with voting procedures. (*Which method is most accurate? Which method is most representative of the majority? In what way could results be influenced?*)

The following tables present the learning content associated with social choice theory. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

Introduction to social choice theory									
Student constructs knowledge with teacher guidance. Secondary									
*	Student applies knowledge by the end of the school year.								
	Student reinvests knowledge.	Cycle Cycle One Two				Cycle Cycle One Two			
		6	1	2	3	4	5		
1.	Makes decisions concerning social choices	_	_						
							*	CS	
	a. Counts and enumerates possibilities					\vdash		S S	
	b. Compares and interprets different voting procedures and their results						*	CS	
	Note : In cases that involve aggregating individual preferences, situations will be limited to no more than 4 "candidates." In particular, students compare and analyze majority rule, plurality voting, the Borda count, the Condorcet method, the elimination or runoff method and approval							Т	
	voting. See Avenues of Exploration in Appendix E of the Secondary Cycle Two Mathematics program, p. 125.							S	

Discrete Mathematics

Matrices

In Secondary Cycle Two, the study of matrices is integrated into various branches of mathematics in the *Technical and Scientific* option. It is based on situations in which the use of matrices is relevant, and the terminology associated with it is introduced when required.

Matrices are a register of representation (grid, table) that can be used to interpret, process and manipulate effectively several data at the same time. Operations such as matrix addition and matrix multiplication with a scalar or another matrix (e.g. purchases/sales, inventory) form the bases of spreadsheet programs. Matrices can also be used to perform geometric transformations [reflections, translations, rotations,¹ dilatations (uniform scaling or homothety)] by using concepts and processes associated with analytic geometry and trigonometry. Solving systems of equations by using row operations on augmented matrices is another example of how matrices are used.

The following tables present the learning content associated with matrices. By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

	Introduction to matrices								
→	Student constructs knowledge with teacher guidance.	tary	Secondary						
*	Student applies knowledge by the end of the school year.	Elemen	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 S	
3.	Performs operations on matrices: addition and subtraction, multiplication with a scalar and with another matrix						→	CST TS S	
4.	Performs geometric transformations (transformation matrices)						*	CST TS S	
5.	Solves systems of equations (augmented matrix)						→	CST TS S	

1. Rotation could be done with measures of significant angles.

Financial Mathematics

During the last year of the Cultural, Social and Technical option, students are introduced to financial mathematics and become familiar with the related vocabulary. Because it is only an introduction, all calculations are performed using previously studied formulas. The following tables present the learning content associated with financial mathematics.

By basing themselves on the concepts and processes targeted, students develop the three competencies of the program, which in turn enable students to better integrate the mathematical concepts and processes presented.

	Introduction to financial mathematics							
→ +	Student constructs knowledge with teacher guidance.	ary	Secondary					
×	Student applies knowledge by the end of the school year.	lement	Су	cle		Cycl	e	
		ш	0	ne		Two	D	
		6	1	2	3	4	5	
1.	Describe the concepts related to financial mathematics							
	a. Interest rates (simple and compound interest)						*	CST
								s
	b. Interest period						*	CST
								TS
							*	CST
	c. Discounting (present value)							TS
			-	-	-		*	S
	d. Compounding (future value)						24	TS
								s
2. Models financial situations			*	CST				
								S
3.	Calculates compounding using the following formula :						*	CST
	$C_n = C_0(1 + i)^n$ (where C_n = future value, C_0 = present value, i = interest rate and n = interest period) Note : Student may use technological tools.							TS
4.	Calculates discounting using the following formula :						*	S CST
	$C_0 = C_n (1+i)^{-n}$ or $C_0 = \frac{C_n}{(1+i)^n}$ (where C_n = future value, C_0 = present value, i = interest rate							TS
	and <i>n</i> = interest period) Note : Student may use technological tools.							S
5.	Determines values or data by solving equations				·	_	*	CST
								S
6.	Compares financial situations						*	CST
								TS
<u> </u>				-	-		*	S
7.	Makes decisions, if necessary, depending on the context						-	TS
								S

Examples of Strategies¹

The strategies that are helpful for the development and use of the three mathematics competencies are integrated into the learning process. It is possible to emphasize some of these strategies, depending on the situation and educational intent. Since students must build their own personal repertoire of strategies, it is important to encourage them to become independent in this regard and help them learn how to use these strategies in different contexts. Students can be encouraged to explore strategies associated with other subject areas, such as reading strategies, as these can be very useful to fully understand all aspects of a question or situation. Please note that the strategies listed below can be used in any order or sequence.

	Cognitive and metacognitive strategies
Planning	 What is the task that I am being asked to perform? What concepts and processes do I need to use? What information is relevant, implicit or explicit? Is some information missing? Do I need to break the task down? How much time will I need to perform this task? What resources will I need? What do I need to establish a work plan?
Comprehension and discrimination	 Am I able to extract the information contained in the registers (type) of representation involved? Which terms seem to have a mathematical meaning different from their meaning in everyday language? What is the purpose of the task? Am I able to explain it in my own words? Do I need to find a counterexample to prove that what I am stating is false? Is all the information pertaining to the situation relevant? Is some information missing? Is there any way I can illustrate the steps involved in the task?
Organization	Should I group, list, classify, reorganize or compare data? Should I use diagrams to show the relationships between objects or data? Can I use objects or technological tools to simulate the situation? Can I use a table or chart? Should I draw up a list? Are the main ideas in my approach well represented? What concepts and mathematical processes should I use? What registers (types) of representation (words, symbols, figures, graphs, tables, etc.) could I use to translate this situation?
Development	 Can I represent the situation mentally or in written form? Have I solved a similar problem before? What additional information could I find using the information I already have? What mathematical concepts could apply? What related properties or processes could I use? Have I used the information that is relevant to the task? Have I considered the unit of measure, if applicable? Can I see a pattern? Which of the following strategies could I adopt? Use trial and error Work backwards Give examples Make suppositions Break the task down Change my point of view or strategy Eliminate possibilities Simplify the task (e.g. reduce the number of data, replace values by values that can be manipulated more readily, rethink the situation with regard to a particular element or case) Translate (mathematize) a situation using a numeric or algebraic expression

Regulation and control	 Is my approach effective and can I explain it? Can I check my solution using reasoning based on an example or a counterexample? What have I learned? How did I learn it? Did I choose an effective reading strategy and take the time I needed to fully understand the task? What are my strengths and weaknesses? Did I adapt my approach to the task? What was the expecte result? How can I explain the difference between the expected result and the actual result? What strategies used by my classmates or suggested by the teacher can I add to my repertoire of strategies? Can I use this approach in other situations?
Generalization	 In what ways are the examples similar or different? Which models can I use again? Can the observations made in a particular case be applied to other situations? Are the assertions I made or conclusions I drew always true? Did I identify examples or counterexamples? Did I see a pattern? Am I able to formulate a rule? Am I able to interpolate or extrapolate?
Retention	 Is what I learned connected in any way to what I already know? Which concepts are the most important for identifying other concepts? Under what conditions does a certain process work? On what properties is it based? Am I able to illustrate or modify the concepts and processes I know? What characteristics would a situation need in order for me to reuse the same strategy? Would I be able to repeat the task again on my own? What methods did I use (e.g. repeated something several times to myself or out loud; highlighted, underlined, circled, recopied important concepts; made a list of terms or symbols)?
Development of automatic processes	 Did I find a solution model and list the steps involved? Did I practise enough in order to be able to repeat the process automatically? Am I able to effectively use the concepts learned? Did I compare my approach to that of others?
Communication	 Did I show enough of my work so that my approach was understandable? What registers (types) of representation (e.g. words, symbols, figures, diagrams/graphs, tables) did I use to interpret a message or convey my message? Did I experiment with different ways of conveying my mathematical message? What method could I use to convey my message? What methods would have been as effective, more effective or less effective? Did I follow the rules and conventions of mathematical language? Did I adapt my message to the audience and the communication intent? How can I adapt it?

	Other strategies
Affective strategies	 How do I feel? What do I like about this situation? Am I satisfied with what I am doing? What did I do particularly well in this situation? What methods did I use to overcome difficulties and which ones helped me the most to reduce my anxiety? stay on task? control my emotions? stay motivated? Am I willing to take risks? What did I succeed at? Do I enjoy exploring mathematical situations?
Resource management strategies	 Whom can I turn to for help and when should I do so? Did I accept the help offered? What documentation (e.g. glossary, ICT) should I use? Will it be helpful? What manipulatives can help me in my task? Did I estimate correctly the time needed for the activity? Did I plan my work well (e.g. planned short, frequent work sessions; set goals to attain for each session)? What methods should I use to stay on task (e.g. appropriate environment, available materials)?

1. These examples are based on strategies developed by the students in elementary school. They are considered to be necessary, if not indispensable, regardless of the level.