Grade 9 Assessment of Mathematics Framework

This framework provides a detailed description of the EQAO Grade 9 Assessment of Mathematics, which is conducted each year in Ontario. The framework also describes how the assessment aligns with the expectations in *The Ontario Curriculum.*

Who Is This Framework For?

This framework has been prepared for
- educators;
- parents, guardians; and
- members of the general public.

Contents
- What Is Assessed?
- The Assessment Process and Design
- The Blueprint
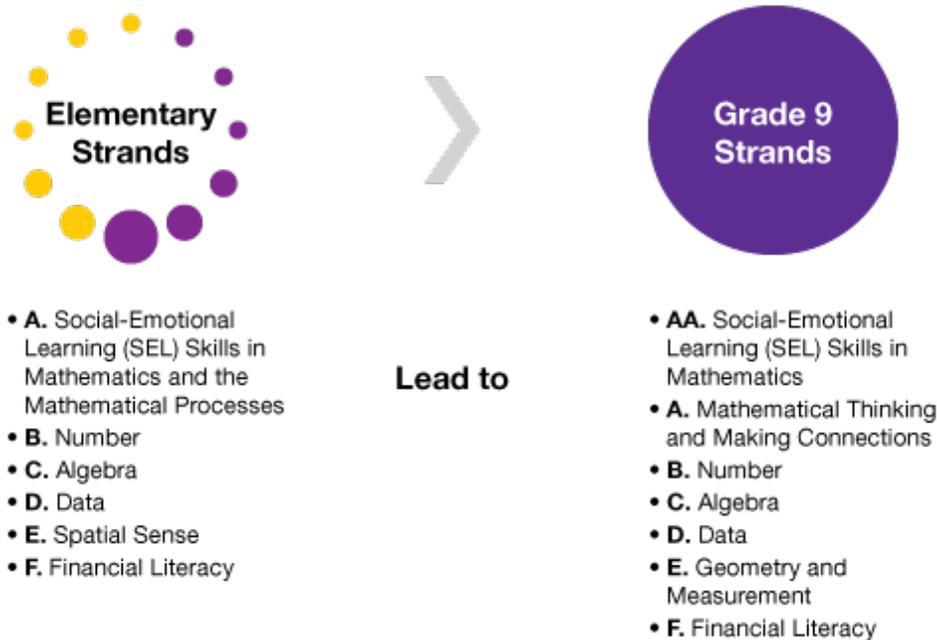- The Scoring and Reporting of Student Results

Grade 9 Assessment of Mathematics

WHAT IS ASSESSED?

What Is Assessed in the Grade 9 Assessment of Mathematics?

Students enrolled in the MTH1W Grade 9 de-streamed mathematics course are learning the knowledge and skills that are defined in the expectations found in the 2021 Ontario Grade 9 mathematics curriculum. The Grade 9 mathematics curriculum was developed to build on learning from *The Ontario Curriculum*, *Grades 1–8: Mathematics,* 2020*,* specifically the Grade 8 curriculum. This Grade 9 mathematics curriculum includes a focus on coding, financial literacy and mathematical modelling, and extends learning in data literacy. The curriculum also emphasizes connections among mathematical concepts, real-life applications and students' lived experiences.

Mathematics spans several content strands. The Grade 9 content strands—Social-Emotional Learning (SEL) Skills in Mathematics[1]; Mathematical Thinking and Making Connections; Number; Algebra; Data; Geometry and Measurement; and Financial Literacy—reflect those of the elementary program, as shown in the following diagram:

Elementary Strands

- **A.** Social-Emotional Learning (SEL) Skills in Mathematics and the Mathematical Processes
- **B.** Number
- **C.** Algebra
- **D.** Data
- **E.** Spatial Sense
- **F.** Financial Literacy

Lead to

Grade 9 Strands

- **AA.** Social-Emotional Learning (SEL) Skills in Mathematics
- **A.** Mathematical Thinking and Making Connections
- **B.** Number
- **C.** Algebra
- **D.** Data
- **E.** Geometry and Measurement
- **F.** Financial Literacy

EQAO's Grade 9 Assessment of Mathematics is a standards-referenced large-scale assessment based on Ontario Grade 9 mathematics curriculum expectations and standards (levels of achievement) for student proficiency. The assessment will consist of questions that cover students' knowledge and skills in the following strands: Number, Algebra, Data, Geometry and Measurement, and Financial Literacy. Although the

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[1] Per 2021–2022 school-year sector direction from the Ministry of Education, social-emotional learning skills will not be assessed, evaluated or reported on.

assessment does not measure the content in the Mathematical Thinking and Making Connections strand, students will be required to apply mathematical processes while completing the assessment. The assessment does not measure the content in the Social-Emotional Learning (SEL) Skills in Mathematics strand.

Mathematics Content Descriptors: Grade 9

The following are highlights of student learning from the MTH1W Grade 9 mathematics course, listed by strand.

Number
- Development of Numbers and Number Sets
  - Development and Use of Numbers
  - Number Sets
- Powers
  - Powers
- Number Sense and Operations
  - Rational Numbers
  - Applications

Algebra
- Algebraic Expressions and Equations
  - Development and Use of Algebra
  - Algebraic Expressions and Equations
- Coding
  - Coding
- Application of Relations
  - Application of Linear and Non-Linear Relations
- Characteristics of Relations
  - Characteristics of Linear and Non-Linear Relations

Data
- Collection, Representation, and Analysis of Data
  - Application of Data
  - Representation and Analysis of Data
- Mathematical Modelling
  - Application of Mathematical Modelling
  - Process of Mathematical Modelling

Geometry and Measurement
- Geometric and Measurement Relationships
  - Geometric and Measurement Relationships

Financial Literacy
- Financial Decisions
  - Financial Decisions

Categories of Knowledge and Skills

Each question on EQAO's Grade 9 Assessment of Mathematics is mapped to an expectation in the Ontario Grade 9 mathematics curriculum and to one of three of the categories of knowledge and skills: Knowledge and Understanding, Application or Thinking. Questions in the Grade 9 assessment are not mapped to the fourth category of knowledge and skills, Communication. EQAO has adapted the definitions of the three categories from the achievement chart found in *The Ontario Curriculum.* The following outlines EQAO's definitions that are used to determine the category for each assessment question.

Knowledge and Understanding

A question is mapped to the category Knowledge and Understanding if in order to answer the question, students must demonstrate only

- subject-specific content (knowledge) and/or
- comprehension of its meaning and significance (understanding).

These questions assess basic knowledge and/or understanding of concepts.

Application

A question is mapped to the category Application if in order to answer the question, students must either

- select the appropriate tool or
- get the necessary information and "fit" it to the problem.

A question may change from Knowledge and Understanding to Application if a context is added or if a tool required to answer the question is not provided.

Thinking

A question is mapped to the category Thinking if in order to answer the question, students must either

- select and sequence a variety of tools or
- demonstrate a critical thinking process (e.g., reasoning).

Students may need to make a plan to answer these questions.

There may be more than one way to answer a mathematics question. EQAO does not assess the process or tools students use to determine their answer on selected-response questions. Each module has questions mapped to each of the categories. The category assigned to each question assumes that students have been taught the knowledge and skills outlined in the Grade 9 curriculum, as the EQAO assessment is completed at the end of the Grade 9 mathematics course.

THE ASSESSMENT PROCESS AND DESIGN

What Is in the Grade 9 Assessment of Mathematics?

The Grade 9 Assessment of Mathematics is an online assessment that consists of various types of selected-response questions, such as drag and drop, drop-down menu, ordering, and single- and multiple-selection questions. During the assessment, students will complete a total of 54 questions that include both operational questions, which count toward a student's final result, and field-test questions.

Introductory Session: Students will have the opportunity to participate in an introductory session that will familiarize them with the assessment. During this introductory session, students will have access to a sample test of 27 questions that shows the various types of questions that may be on the assessment. During the sample test, students will also be able to try out the tools (e.g., text-to-speech, zoom in and zoom out, calculator) available during the assessment. The sample test is also available on the EQAO public website.

Assessment Sessions: Students will complete the assessment in two sessions: Session A and Session B. Each session is designed to be completed in approximately 60 minutes, and students must complete each session in one sitting. The sessions can be attempted one after the other, either back to back with a short break in between or on two different dates and times.

The assessment contains 54 questions (50 operational and four field-test questions) that are from the content strands (Number, Algebra, Data, Geometry and Measurement, and Financial Literacy). The four embedded field-test questions are not considered when determining a student's final result and are fewer than 10% of the total number of questions completed by students.

Grade 9 Assessment of Mathematics Number of Questions	
Question Type	**Number of Questions**
Operational	50
Field Test	4
Total Number of Questions for Each Student	54

Questionnaire Session: At the end of the two assessment sessions, students will be presented with a questionnaire that asks them about their attitudes and perceptions with respect to mathematics, transferable skills and their learning environment. EQAO will use this data to provide schools, boards, teachers and parents/guardians with information on how students' attitudes and perceptions are related to their mathematics achievement.
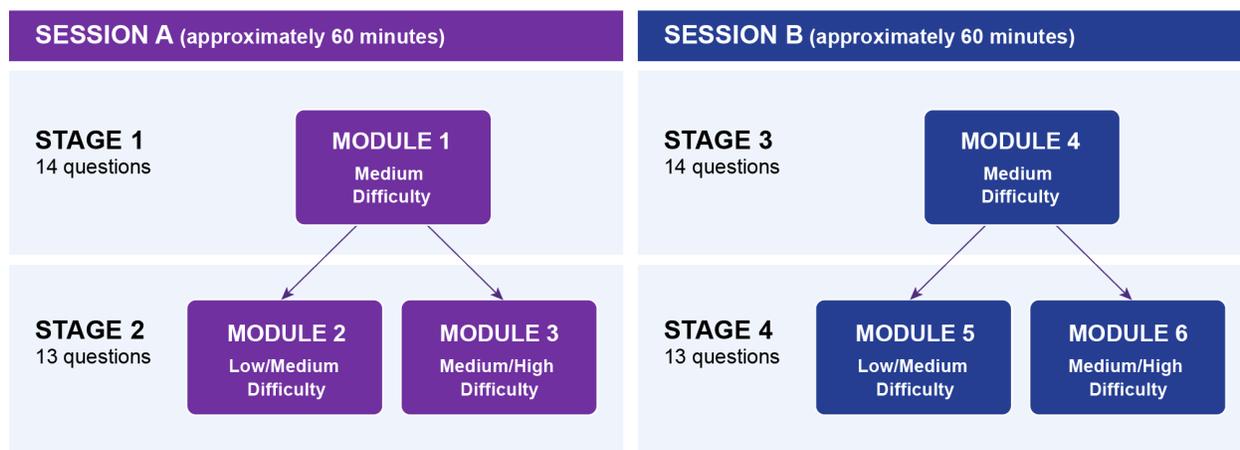
INTRODUCTORY SESSION

ASSESSMENT SESSION A	ASSESSMENT SESSION B
27 Questions	27 Questions

QUESTIONNAIRE SESSION

What Is the Design of the Grade 9 Assessment of Mathematics?

The Grade 9 Assessment of Mathematics uses a multi-stage computer adaptive testing model that adapts to the individual student's performance as the student progresses through the two assessment sessions.

Each session is made up of two stages: the set of questions presented to students in the second stage is determined by their performance on the previous stage. Each stage is made up of modules that contain a set of questions of a specific overall level of difficulty (medium, low/medium or medium/high). Each module has questions that range in difficulty.

Each student begins Session A by completing a set of questions with a medium overall level of difficulty contained in a module (Module 1 of Stage 1, as illustrated in the diagram below). Based on their performance on the operational questions in this first module, students are presented with a new module in Stage 2 with an overall level of difficulty of low/medium (Module 2) or medium/high (Module 3). The same process repeats for Session B.

For more information, refer to the literature review: Leveraging Multi-Stage Computer Adaptive Testing for Large-Scale Assessments—EQAO.

SESSION A (approximately 60 minutes)

STAGE 1 14 questions — **MODULE 1** Medium Difficulty

STAGE 2 13 questions — **MODULE 2** Low/Medium Difficulty — **MODULE 3** Medium/High Difficulty

SESSION B (approximately 60 minutes)

STAGE 3 14 questions — **MODULE 4** Medium Difficulty

STAGE 4 13 questions — **MODULE 5** Low/Medium Difficulty — **MODULE 6** Medium/High Difficulty

Any field-test questions in Stage 1 and Stage 3 are not considered when determining the module the student will be routed to in the next stage.

Understanding Ontario's Student Achievement Levels

After all the questions in a student's assessment are scored, the data from the operational questions are used to determine the student's overall level of achievement. The Individual Student Report shows both the level and the range within the level at which the student performed. This may provide information for parents/guardians and teachers to use in planning for improvement.

EQAO uses the definitions from the Ontario Ministry of Education levels of achievement for the levels it reports: Level 1 represents achievement that falls much below the provincial standard. Level 2 represents achievement that is below but approaching the provincial standard. Level 3 represents achievement at the provincial standard. Level 4 identifies achievement that surpasses the provincial standard. The characteristics given for Level 3 in the achievement charts in *The Ontario Curriculum* correspond to the provincial standard for achievement of the curriculum expectations. Parents/guardians of students achieving Level 3 can be confident that their children will be prepared for work in the next grade.

It should be noted that achievement at Level 4 does not mean that the student has achieved expectations beyond those specified for a particular grade.

THE BLUEPRINT

How Are Curriculum Expectations Reflected in the Grade 9 Assessment of Mathematics?

The blueprint for the Grade 9 Assessment of Mathematics includes the overall and specific expectations from the Ontario curriculum for the MTH1W Grade 9 de-streamed mathematics course. The blueprint also provides the number of operational questions and the percentage of questions from each strand on the assessment that count toward the student's result.

The Mathematical Processes
Although the Grade 9 assessment does not measure the mathematical processes, these are the processes through which students apply mathematical knowledge, concepts and skills.
Problem Solving
Reasoning and Proving
Reflecting
Connecting
Communicating
Representing
Selecting Tools and Strategies

Grade 9 Assessment of Mathematics Blueprint

Grade 9 Mathematics Curriculum Expectation		Number of Questions	Percentage of Questions on the Assessment
B	**Number**		
B1	**Development of Numbers and Number Sets**		
	demonstrate an understanding of the development and use of numbers, and make connections between sets of numbers		
	Specific Expectations for Overall B1		
	Development and Use of Numbers		
B1.1	research a number concept to tell a story about its development and use in a specific culture, and describe its relevance in a current context		
	Number Sets		
B1.2	describe how various subsets of a number system are defined, and describe similarities and differences between these subsets		
B1.3	use patterns and number relationships to explain density, infinity, and limit as they relate to number sets		
B2	**Powers**		
	represent numbers in various ways, evaluate powers, and simplify expressions by using the relationships between powers and their exponents		
	Specific Expectations for Overall B2		
	Powers		
B2.1	analyse, through the use of patterning, the relationship between the sign and size of an exponent and the value of a power, and use this relationship to express numbers in scientific notation and evaluate powers	10	$\dfrac{10}{50} = 20\%$ of the questions on the assessment
B2.2	analyse, through the use of patterning, the relationships between the exponents of powers and the operations with powers, and use these relationships to simplify numeric and algebraic expressions		
B3	**Number Sense and Operations**		
	apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems		
	Specific Expectations for Overall B3		
	Rational Numbers		
B3.1	apply an understanding of integers to describe location, direction, amount, and changes in any of these, in various contexts		
B3.2	apply an understanding of unit fractions and their relationship to other fractional amounts, in various contexts, including the use of measuring tools		
B3.3	apply an understanding of integers to explain the effects that positive and negative signs have on the values of ratios, rates, fractions, and decimals, in various contexts		
	Applications		
B3.4	solve problems involving operations with positive and negative fractions and mixed numbers, including problems involving formulas, measurements, and linear relations, using technology when appropriate		
B3.5	pose and solve problems involving rates, percentages, and proportions in various contexts, including contexts connected to real-life applications of data, measurement, geometry, linear relations, and financial literacy		

	Grade 9 Mathematics Curriculum Expectation	Number of Questions	Percentage of Questions on the Assessment
C	**Algebra**		
C1	**Algebraic Expressions and Equations**		
	demonstrate an understanding of the development and use of algebraic concepts and of their connection to numbers, using various tools and representations		
	Specific Expectations for Overall C1		
	Development and Use of Algebra		
C1.1	research an algebraic concept to tell a story about its development and use in a specific culture, and describe its relevance in a current context		
	Algebraic Expressions and Equations		
C1.2	create algebraic expressions to generalize relationships expressed in words, numbers, and visual representations, in various contexts		
C1.3	compare algebraic expressions using concrete, numerical, graphical, and algebraic methods to identify those that are equivalent, and justify their choices		
C1.4	simplify algebraic expressions by applying properties of operations of numbers, using various representations and tools, in different contexts		
C1.5	create and solve equations for various contexts, and verify their solutions		
C2	**Coding**		
	apply coding skills to represent mathematical concepts and relationships dynamically, and to solve problems, in algebra and across the other strands		
	Specific Expectations for Overall C2		
	Coding	18	$\dfrac{18}{50} = 36\%$ of the questions on the assessment
C2.1	use coding to demonstrate an understanding of algebraic concepts including variables, parameters, equations, and inequalities		
C2.2	create code by decomposing situations into computational steps in order to represent mathematical concepts and relationships, and to solve problems		
C2.3	read code to predict its outcome, and alter code to adjust constraints, parameters, and outcomes to represent a similar or new mathematical situation		
C3	**Application of Relations**		
	represent and compare linear and non-linear relations that model real-life situations, and use these representations to make predictions		
	Specific Expectations for Overall C3		
	Application of Linear and Non-Linear Relations		
C3.1	compare the shapes of graphs of linear and non-linear relations to describe their rates of change, to make connections to growing and shrinking patterns, and to make predictions		
C3.2	represent linear relations using concrete materials, tables of values, graphs, and equations, and make connections between the various representations to demonstrate an understanding of rates of change and initial values		
C3.3	compare two linear relations of the form $y = ax + b$ graphically and algebraically, and interpret the meaning of their point of intersection in terms of a given context		

Grade 9 Mathematics Curriculum Expectation		Number of Questions	Percentage of Questions on the Assessment
C	**Algebra Continued**		
C4	**Characteristics of Relations**		
	demonstrate an understanding of the characteristics of various representations of linear and non-linear relations, using tools, including coding when appropriate		
	Specific Expectations for Overall C4		
	Characteristics of Linear and Non-Linear Relations		
C4.1	compare characteristics of graphs, tables of values, and equations of linear and non-linear relations	Continued from previous page	Continued from previous page
C4.2	graph relations represented as algebraic equations of the forms $x = $ k, $y = $ k, $x + y = $ k, $x - y = $ k, $a x + b y = $ k, and $xy = $ k, and their associated inequalities, where a, b, and k are constants, to identify various characteristics and the points and/or regions defined by these equations and inequalities		
C4.3	translate, reflect, and rotate lines defined by $y = $ ax, where a is a constant, and describe how each transformation affects the graphs and equations of the defined lines		
C4.4	determine the equations of lines from graphs, tables of values, and concrete representations of linear relations by making connections between rates of change and slopes, and between initial values and y-intercepts, and use these equations to solve problems		
D	**Data**		
D1	**Collection, Representation and Analysis of Data**		
	describe the collection and use of data, and represent and analyse data involving one and two variables		
	Specific Expectations for Overall D1		
	Application of Data		
D1.1	identify a current context involving a large amount of data, and describe potential implications and consequences of its collection, storage, representation, and use		
	Representation and Analysis of Data		
D1.2	represent and statistically analyse data from a real-life situation involving a single variable in various ways, including the use of quartile values and box plots		
D1.3	create a scatter plot to represent the relationship between two variables, determine the correlation between these variables by testing different regression models using technology, and use a model to make predictions when appropriate	8	$\frac{8}{50} = 16\%$ of the questions on the assessment
D2	**Mathematical Modelling**		
	apply the process of mathematical modelling, using data and mathematical concepts from other strands, to represent, analyse, make predictions, and provide insight into real-life situations		
	Specific Expectations for Overall D2		
	Application of Mathematical Modelling		
D2.1	describe the value of mathematical modelling and how it is used in real life to inform decisions		
	Process of Mathematical Modelling		
D2.2	identify a question of interest requiring the collection and analysis of data, and identify the information needed to answer the question		
D2.3	create a plan to collect the necessary data on the question of interest from an appropriate source, identify assumptions, identify what may vary and what may remain the same in the situation, and then carry out the plan		

Grade 9 Mathematics Curriculum Expectation		Number of Questions	Percentage of Questions on the Assessment
D	**Data continued**		
D2.4	determine ways to display and analyse the data in order to create a mathematical model to answer the original question of interest, taking into account the nature of the data, the context, and the assumptions made	Continued from previous page	Continued from previous page
D2.5	report how the model can be used to answer the question of interest, how well the model fits the context, potential limitations of the model, and what predictions can be made based on the model		
E	**Geometry and Measurement**		
E1	**Geometric and Measurement Relationships**	8	$\frac{8}{50}$ = 16% of the questions on the assessment
	demonstrate an understanding of the development and use of geometric and measurement relationships, and apply these relationships to solve problems, including problems involving real-life situations		
	Specific Expectations for Overall E1		
	Geometric and Measurement Relationships		
E1.1	research a geometric concept or a measurement system to tell a story about its development and use in a specific culture or community, and describe its relevance in connection to careers and to other disciplines		
E1.2	create and analyse designs involving geometric relationships and circle and triangle properties, using various tools		
E1.3	solve problems involving different units within a measurement system and between measurement systems, including those from various cultures or communities, using various representations and technology, when appropriate		
E1.4	show how changing one or more dimensions of a two-dimensional shape and a three-dimensional object affects perimeter/circumference, area, surface area, and volume, using technology when appropriate		
E1.5	solve problems involving the side-length relationship for right triangles in real-life situations, including problems that involve composite shapes		
E1.6	solve problems using the relationships between the volume of prisms and pyramids and between the volume of cylinders and cones, involving various units of measure		
F	**Financial Literacy**		
F1	**Financial Decisions**	6	$\frac{6}{50}$ = 12% of the questions on the assessment
	demonstrate the knowledge and skills needed to make informed financial decisions		
	Specific Expectations for Overall F1		
	Financial Decisions		
F1.1	identify a past or current financial situation and explain how it can inform financial decisions, by applying an understanding of the context of the situation and related mathematical knowledge		
F1.2	identify financial situations that involve appreciation and depreciation, and use associated graphs to answer related questions		
F1.3	compare the effects that different interest rates, lengths of borrowing time, ways in which interest is calculated, and amounts of down payments have on the overall costs associated with purchasing goods or services, using appropriate tools		
F1.4	modify budgets displayed in various ways to reflect specific changes in circumstances, and provide a rationale for the modifications		

THE SCORING AND REPORTING OF STUDENT RESULTS

How Are the Questions on the Grade 9 Assessment of Mathematics Scored?

All the questions on the mathematics assessment are scored automatically (computer-scored).

How Is a Student's Overall Level of Achievement Determined?

The Individual Student Report provides a level for each student. This information enables students, parents/guardians and teachers to plan for improvement. A student's outcome is assigned using a statistical procedure that takes into account the student's responses to all the operational questions on the assessment *and* the difficulty of each of these questions, regardless of how the student is routed. This procedure, known as Item Response Theory, assumes a continuum of ability in mathematics knowledge and skills (as reflected by the achievement level 1 to 4), and locates the student's outcome along that continuum.

The Individual Student Report provides this outcome by indicating the overall level of achievement for the student and showing where on the continuum the student's results are located.

Teachers will provide the Individual Student Reports to students to share with their parents/guardians. The following is a sample Individual Student Report.

EQAO

Assessment of Mathematics, Grade 9
Individual Student Report, YEAR

SAMPLE NAME

Ontario Education Number:	000-000-000
School:	Sample School
School Board:	Sample Board
Date of Generation:	DD-MM-YY

STUDENT RESULTS

Thank you for participating in the online Grade 9 Assessment of Mathematics, which measures the knowledge and skills students are expected to have learned by the end of the Ontario Grade 9 mathematics course (MTH1W). The assessment is a multi-stage computer adaptive test that adjusts its difficulty according to the student's ability as the student progresses through each session.

	NE 1 Not enough evidence to be assigned a Level 1 0 to 49%	Level 1 Much below the provincial standard 50 to 59%	Level 2 Approaches the provincial standard 60 to 69%	Level 3 Meets the provincial standard 70 to 79%	Level 4 Surpasses the provincial standard 80 to 100%
Overall Level: 3					

These results give a measure of the student's achievement in mathematics in relation to the provincial standard.

The provincial standard is Level 3. The four achievement levels are the same levels teachers use in the classroom to evaluate students' progress. The percentages associated with each level are based on those outlined in the Ministry of Education's Achievement Chart for Grade 9 Mathematics.

NOTE:

Individual student results are provided soon after students complete the assessment. Results at the school, board and provincial levels will be released in the fall.

Please share the results of your performance on the EQAO Grade 9 Assessment of Mathematics with your parents and/or guardians.

EQAO conducts province-wide assessments at the primary, junior and secondary levels to measure student achievement against curriculum expectations. The data are widely used as an additional tool to guide improvements in education at the individual, school and provincial levels. For additional information and useful resources, visit www.eqao.com.

This report contains personal information that is protected under the *Freedom of Information and Protection of Privacy Act.*