



Learning

Outcomes

Framework

May 2004

Mathematics
Grades 7–9

**Learning Outcomes Framework
Mathematics
Grades 7–9**

Grade 7

General Curriculum Outcomes Specific Curriculum Outcomes

GCO A: Students will demonstrate number sense and apply number-theory concepts.

Students will be expected to

- A1 model and use power, base, and exponent to represent repeated multiplication
- A2 rename numbers among exponential, standard and expanded forms
- A3 rewrite large numbers from standard form to scientific notation and vice versa
- A4 solve and create problems involving common factors and greatest common factors (GCF)
- A5 solve and create problems involving common multiples and least common multiples (LCM)
- A6 develop and apply divisibility rules for 3, 4, 6, and 9
- A7 apply patterning in renaming numbers from fractions and mixed numbers to decimal numbers
- A8 rename single-digit and double-digit repeating decimals to fractions through the use of patterns, and use these patterns to make predictions
- A9 compare and order proper and improper fractions, mixed numbers, and decimal numbers
- A10 illustrate, explain, and express ratios, fractions, decimals, and percents in alternative forms
- A11 demonstrate number sense for percent
- A12 represent integers (including zero) concretely, pictorially, and symbolically, using a variety of models
- A13 compare and order integers

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

- B1 use estimation strategies to assess and justify the reasonableness of calculation results for integers and decimal numbers
- B2 use mental math strategies for calculations involving integers and decimal numbers
- B3 demonstrate understanding of the properties of operations with decimal numbers and integers
- B4 determine and use the most appropriate computational method in problem situations involving whole numbers and/or decimals
- B5 apply the order of operations for problems involving whole and decimal numbers
- B6 estimate sum or difference of fractions when appropriate
- B7 multiply mentally a fraction by whole numbers and vice versa
- B8 estimate and determine percent when given the part and the whole

General Curriculum Outcomes Specific Curriculum Outcomes

Students will be expected to

	B9	estimate and determine the percent of a number
	B10	create and solve problems that involve the use of percent
	B11	add and subtract integers concretely, pictorially, and symbolically to solve problems
	B12	multiply integers concretely, pictorially, and symbolically to solve problems
	B13	divide integers concretely, pictorially, and symbolically to solve problems
	B14	solve and pose problems that utilize addition, subtraction, multiplication, and division of integers
	B15	apply the order of operations to integers
	B16	create and evaluate simple variable expressions by recognizing that the four operations apply in the same way as they do for numerical expressions
	B17	distinguish between like and unlike terms
	B18	add and subtract like terms by recognizing the parallel with numerical situations, using concrete and pictorial models
GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and informally.	C1	describe a pattern, using written and spoken language and tables and graphs
	C2	summarize simple patterns, using constants, variables, algebraic expressions, and equations, and use them in making predictions
	C3	explain the difference between algebraic expressions and algebraic equations
	C4	solve one- and two-step single-variable linear equations, using systematic trial
	C5	illustrate the solution for one- and two-step single-variable linear equations, using concrete materials and diagrams
	C6	graph linear equations, using a table of values
	C7	interpolate and extrapolate number values from a given graph
	C8	determine if an ordered pair is a solution to a linear equation
	C9	construct and analyse graphs to show how change in one quantity affects a related quantity
GCO D: Students will demonstrate an understanding of and apply concepts and skills associated with measurement.	D1	identify, use, and convert among the SI units to measure, estimate, and solve problems that relate to length, area, volume, mass, and capacity
	D2	apply concepts and skills related to time in problem situations
	D3	develop and use rate as a tool for solving indirect measurement problems in a variety of contexts

General Curriculum Outcomes Specific Curriculum Outcomes

Students will be expected to

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.	D4	construct and analyse graphs of rates to show how change in one quantity affects a related quantity
	D5	demonstrate an understanding of the relationships among diameter, radii, and circumference of circles, and use the relationships to solve problems
	E1	decide and justify which combinations of triangle classifications are possible, through construction using materials and/or technology
	E2	determine and use relationships between angle measures and side lengths in triangles
	E3	construct angle bisectors and perpendicular bisectors, using a variety of methods
	E4	apply angle pair relationships to find missing angle measures
	E5	identify, construct, classify, and use angle pair relationships pertaining to parallel lines and non-parallel lines and their transversals
	E6	apply angle relationships to find angle measures
	E7	explain, using a model, why the sum of the measures of the angles of a triangle is 180°
	E8	sketch and build 3-D objects, using a variety of materials and information about the objects
GCO F: Students will solve problems involving the collection, display, and analysis of data.	E9	draw, describe, and apply translations, reflections, and rotations, and their combinations, and identify and use the properties associated with these transformations
	E10	create and describe designs using translation, rotation, and reflection
	F1	communicate through example the distinction between biased and unbiased sampling, and first- and second-hand data
	F2	formulate questions for investigation from relevant contexts
	F3	select, defend, and use appropriate data collection methods and evaluate issues to be considered when collecting data
	F4	construct a histogram
	F5	construct appropriate data displays, grouping data where appropriate and taking into consideration the nature of the data
	F6	read and make inferences for grouped and ungrouped data displays
	F7	formulate statistics projects to explore current issues from within mathematics, other subject areas, or the world of students

General Curriculum Outcomes Specific Curriculum Outcomes

Students will be expected to

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| GCO G: Students will represent and solve problems involving uncertainty. | F8 determine measures of central tendency and how they are affected by data presentations and fluctuations |
| | F9 draw inferences and make predictions based on the variability of data sets, using range and the examination of outliers, gaps, and clusters |
| | G1 identify situations for which the probability would be near 0, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 |
| | G2 solve probability problems, using simulations and by conducting experiments |
| | G3 identify all possible outcomes of two independent events, using tree diagrams and area models |
| | G4 create and solve problems, using the numerical definition of probability |
| | G5 compare experimental results with theoretical results |
| | G6 use fractions, decimals, and percents as numerical expressions to describe probability |

Grade 8

General Curriculum Outcomes Specific Curriculum Outcomes

GCO A: Students will demonstrate number sense and apply number-theory concepts.

Students will be expected to

- A1 model and link various representations of square root of a number
- A2 recognize perfect squares between 1 and 144 and apply patterns related to them
- A3 distinguish between an exact square root of a number and its decimal approximation
- A4 find the square root of any number, using an appropriate method
- A5 demonstrate and explain the meaning of negative exponents for base ten
- A6 represent any number written in scientific notation in standard form, and vice versa
- A7 compare and order integers and positive and negative rational numbers (in decimal and fractional forms)
- A8 represent and apply fractional percents, and percents greater than 100, in fraction or decimal form, and vice versa
- A9 solve proportion problems that involve equivalent ratios and rates

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

- B1 demonstrate an understanding of the properties of operations with integers and positive and negative rational numbers (in decimal and fractional forms)
- B2 solve problems involving proportions, using a variety of methods
- B3 create and solve problems which involve finding a, b, or c in the relationship $a\%$ of $b = c$, using estimation and calculation
- B4 apply percentage increase and decrease in problem situations
- B5 add and subtract fractions concretely, pictorially, and symbolically
- B6 add and subtract fractions mentally, when appropriate
- B7 multiply fractions concretely, pictorially, and symbolically
- B8 divide fractions concretely, pictorially, and symbolically
- B9 estimate and mentally compute products and quotients involving fractions
- B10 apply the order of operations to fraction computations, using both pencil and paper and the calculator
- B11 model, solve, and create problems involving fractions in meaningful contexts

General Curriculum Outcomes Specific Curriculum Outcomes

Students will be expected to

	B12	add, subtract, multiply, and divide positive and negative decimal numbers with and without the calculator
	B13	solve and create problems involving addition, subtraction, multiplication, and division of positive and negative decimal numbers
	B14	add and subtract algebraic terms concretely, pictorially, and symbolically to solve simple algebraic problems
	B15	explore addition and subtraction of polynomial expressions, concretely and pictorially
	B16	demonstrate an understanding of multiplication of a polynomial by a scalar, concretely, pictorially, and symbolically
GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and informally.	C1	represent patterns and relationships in a variety of formats and use these representations to predict unknown values
	C2	interpret graphs that represent linear and non-linear data
	C3	construct and analyse tables and graphs to describe how change in one quantity affects a related quantity
	C4	link visual characteristics of slope with its numerical value by comparing vertical change with horizontal change
	C5	solve problems involving the intersection of two lines on a graph
	C6	solve and verify simple linear equations algebraically
	C7	create and solve problems, using linear equations
GCO D: Students will demonstrate an understanding of and apply concepts and skills associated with measurement.	D1	solve indirect measurement problems, using proportions
	D2	solve measurement problems, using appropriate SI units
	D3	estimate areas of circles
	D4	develop and use the formula for the area of a circle
	D5	describe patterns and generalize the relationships between areas and perimeters of quadrilaterals, and areas and circumferences of circles
	D6	calculate the areas of composite figures
	D7	estimate and calculate volumes and surface areas of right prisms and cylinders
	D8	measure and calculate volumes and surface areas of composite 3-D shapes
	D9	demonstrate an understanding of the Pythagorean relationship, using models
	D10	apply the Pythagorean relationship in problem situations

General Curriculum Outcomes Specific Curriculum Outcomes

Students will be expected to

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

- E1 demonstrate whether a set of orthogonal views, a map plan, and an isometric drawing can represent more than one 3-D shape
- E2 examine and draw representations of 3-D shapes to determine what is necessary to produce unique shapes
- E3 draw, describe, and apply transformations of 3-D shapes
- E4 analyse polygons to determine their properties and interrelationships
- E5 represent, analyse, describe, and apply dilations

GCO F: Students will solve problems involving the collection, display, and analysis of data.

- F1 demonstrate an understanding of the variability of repeated samples of the same population
- F2 develop and apply the concept of randomness
- F3 construct and interpret circle graphs
- F4 construct and interpret scatter plots and determine a line of best fit by inspection
- F5 construct and interpret box-and-whisker plots
- F6 extrapolate and interpolate information from graphs
- F7 determine the effect of variations in data on the mean, median, and mode
- F8 develop and conduct statistics projects to solve problems
- F9 evaluate data interpretations that are based on graphs and tables

GCO G: Students will represent and solve problems involving uncertainty.

- G1 conduct experiments and simulations to find probabilities of single and complementary events
- G2 determine theoretical probabilities of single and complementary events
- G3 compare experimental and theoretical probabilities
- G4 demonstrate an understanding of how data is used to establish broad probability patterns

Grade 9

General Curriculum Outcomes Specific Curriculum Outcomes

GCO A: Students will demonstrate number sense and apply number-theory concepts.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Students will be expected to

- A1 investigate problems involving square root and principal square root
- A2 graph and write in symbols and in words the solution set for equations and inequations involving integers and other real numbers
- A3 demonstrate an understanding of the meaning and uses of irrational numbers
- A4 interrelate subsets of the set of real numbers
- A5 compare and order real numbers
- A6 represent problem situations using matrices

- B1 model, solve, and create problems involving real numbers
- B2 add, subtract, multiply, and divide rational numbers in fractional and decimal forms using the most appropriate methods
- B3 apply the order of operations in rational number computations
- B4 demonstrate an understanding of and apply the exponent laws for integral exponents
- B5 model, solve, and create problems involving numbers expressed in scientific notation
- B6 judge the reasonableness of results in problem situations involving square roots, rational numbers, and numbers written in scientific notation
- B7 model, solve, and create problems involving the matrix operations of addition, subtraction, and scalar multiplication
- B8 add and subtract polynomial expressions symbolically to solve problems
- B9 find products of two monomials, a monomial and a polynomial, and two binomials concretely, pictorially, and symbolically
- B10 find quotients of polynomials with monomial divisors
- B11 evaluate polynomial expressions
- B12 factor algebraic expressions with common monomial factors concretely, pictorially, and symbolically
- B13 demonstrate an understanding of the applicability of commutative, associative, distributive, identity, and inverse properties to operations involving algebraic expressions
- B14 select and use appropriate strategies in problem situations

General Curriculum Outcomes Specific Curriculum Outcomes

Students will be expected to

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and informally.

- C1 represent patterns and relationships in a variety of formats and use these representations to predict and justify unknown values
- C2 interpret graphs that represent linear and non-linear data
- C3 construct and analyse tables and graphs to describe how changes in one quantity affect a related quantity
- C4 determine the equations of lines by obtaining their slopes and y -intercepts from graphs and sketch graphs of equations using y -intercepts and slopes
- C5 explain the connections among different representations of patterns and relationships
- C6 solve single-variable equations algebraically and verify the solutions
- C7 solve first-degree single-variable inequalities algebraically, verify the solutions, and display them on number lines
- C8 solve and create problems involving linear equations and inequalities

GCO D: Students will demonstrate an understanding of and apply concepts and skills associated with measurement.

- D1 apply rates, other ratios, and proportions in indirect measurement problems with particular focus on slopes
- D2 solve measurement problems involving conversion among SI units
- D3 relate the volumes of pyramids and cones to the volumes of corresponding prisms and cylinders
- D4 estimate, measure, and calculate volumes and surface areas of pyramids, cones, and spheres and apply these measures
- D5 demonstrate understanding of and apply ratios within similar triangles

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

- E1 investigate and demonstrate an understanding of the minimum sufficient conditions to produce unique triangles
- E2 investigate and demonstrate an understanding of the properties of and the minimum sufficient conditions to guarantee congruent triangles
- E3 make informal deductions using congruent triangle and angle properties
- E4 demonstrate an understanding of and apply the properties of similar triangles
- E5 relate congruence and similarity of triangles
- E6 use mapping notation to represent translations, reflections, rotations, and dilatations of geometric figures and interpret such notations

General Curriculum Outcomes Specific Curriculum Outcomes

Students will be expected to

GCO F: Students will solve problems involving the collection, display, and analysis of data.

- E7 analyse and represent transformations and combinations of transformations using mapping notation
- E8 investigate, determine, and apply the effects of transformations of geometric figures on congruence, similarity, and orientation
- F1 determine the strength of the relationships in scatter plots
- F2 sketch lines of best fit and determine their equations
- F3 sketch curves of best fit for relationships that appear to be non-linear
- F4 select, defend, and use the most appropriate methods for displaying data
- F5 draw inferences and make predictions based on data analysis and data displays
- F6 demonstrate an understanding of the role of data management in society
- F7 evaluate arguments and interpretations that are based on data analysis

GCO G: Students will represent and solve problems involving uncertainty.

- G1 make predictions of, and conduct experiments and simulations to determine, probabilities involving dependent and independent events
- G2 determine theoretical probabilities of compound events
- G3 compare experimental and theoretical probabilities
- G4 recognize and explain why decisions based on probabilities may be combinations of theoretical calculations, experimental results, and subjective judgments