

New Jersey Core Curriculum Content Standards for Mathematics	Boardworks Middle School Math Presentations
Grade 6	
STANDARD 4.1 (NUMBER AND NUMERICAL OPERATIONS) ALL STUDENTS WILL DEVELOP NUMBER SENSE AND WILL PERFORM STANDARD NUMERICAL OPERATIONS AND ESTIMATIONS ON ALL TYPES OF NUMBERS IN A VARIETY OF WAYS.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 6, students will:	
4.1.6 A. Number Sense	
1. Use real-life experiences, physical materials, and technology to construct meanings for numbers (unless otherwise noted, all indicators for grade 6 pertain to these sets of numbers as well).	
- All integers	Using negative numbers in context Absolute value Ordering integers Place value
- All fractions as part of a whole, as subset of a set, as a location on a number line, and as divisions of whole numbers	Fractions of shapes One number as a fraction of another Equivalent fractions Ordering fractions
- All decimals	Ordering decimals Using a calculator
2. Recognize the decimal nature of United States currency and compute with money.	Ratio and proportion problems Calculating percentages mentally Calculating percentages on paper Calculating percentages with a calculator
3. Demonstrate a sense of the relative magnitudes of numbers.	Ordering decimals Ordering integers Ordering fractions Using negative numbers in context Absolute value
4. Explore the use of ratios and proportions in a variety of situations.	Ratio and rate Dividing in a given ratio Direct proportion Ratio and proportion problems

5. Understand and use whole-number percents between 1 and 100 in a variety of situations.	Introducing percentages Equivalent fractions, decimals and percentages Calculating percentages mentally Calculating percentages on paper Calculating percentages with a calculator Comparing proportions
6. Use whole numbers, fractions, and decimals to represent equivalent forms of the same number.	Equivalent fractions, decimals and percentages Equivalent fractions Fractions and decimals
7. Develop and apply number theory concepts in problem solving situations.	
- Primes, factors, multiples	Prime numbers
- Common multiples, common factors	Multiples and factors
- Least common multiple, greatest common factor	Multiples and factors
8. Compare and order numbers.	GCF and LCM Ordering integers Ordering decimals Ordering fractions Equivalent fractions, decimals and percentages Equivalent fractions Fractions and decimals Using negative numbers in context
4.1.6 B. Numerical Operations	
1. Recognize the appropriate use of each arithmetic operation in problem situations.	Adding and subtracting integers activities Using negative numbers in context Mental math puzzles
2. Construct, use, and explain procedures for performing calculations with fractions and decimals with:	
- Pencil-and-paper	Written methods for addition and subtraction Written methods for multiplication Written methods for division Methods for adding and subtracting fractions Multiplying fractions Dividing by fractions

- Mental math	Mental addition and subtraction Mental multiplication Mental division Mental math and place value Multiplying by numbers between 0 and 1 Mental math puzzles Adding and subtracting simple fractions
- Calculator	Using a calculator Methods for adding and subtracting fractions Multiplying and dividing integers
3. Use an efficient and accurate pencil-and-paper procedure for division of a 3-digit number by a 2-digit number.	Written methods for division
4. Select pencil-and-paper, mental math, or a calculator as the appropriate computational method in a given situation depending on the context and numbers.	-
5. Find squares and cubes of whole numbers.	Square and triangular numbers Cubes and cube roots
6. Check the reasonableness of results of computations.	Checking results Using a calculator Estimation and approximation
7. Understand and use the various relationships among operations and properties of operations.	Properties of numbers
8. Understand and apply the standard algebraic order of operations for the four basic operations, including appropriate use of parentheses.	Order of operations and PEMDAS
4.1.6 C. Estimation	
1. Use a variety of strategies for estimating both quantities and the results of computations.	Estimation and approximation
2. Recognize when an estimate is appropriate, and understand the usefulness of an estimate as distinct from an exact answer.	Estimation and approximation Estimating measurements
3. Determine the reasonableness of an answer by estimating the result of operations.	Estimation and approximation Using a calculator
4. Determine whether a given estimate is an overestimate or an underestimate.	-
STANDARD 4.2 (GEOMETRY AND MEASUREMENT) ALL STUDENTS WILL DEVELOP SPATIAL SENSE AND THE ABILITY TO USE GEOMETRIC PROPERTIES, RELATIONSHIPS, AND MEASUREMENT TO MODEL, DESCRIBE AND ANALYZE PHENOMENA.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 6, students will:	
4.2.6 A. Geometric Properties	
1. Understand and apply concepts involving lines and angles.	
- Notation for line, ray, angle, line segment	Labeling lines and angles

- Properties of parallel, perpendicular, and intersecting lines	Parallel and perpendicular lines
- Sum of the measures of the interior angles of a triangle is 180°	Angles in a triangle
2. Identify, describe, compare, and classify polygons and circles.	
- Triangles by angles and sides	Triangles Angles in a triangle
- Quadrilaterals, including squares, rectangles, parallelograms, trapezoids, rhombi	Quadrilaterals
- Polygons by number of sides.	Polygons
- Equilateral, equiangular, regular	Triangles The sum of interior and exterior angles
- All points equidistant from a given point form a circle	Circles
3. Identify similar figures.	Congruence
	Congruence Reflection symmetry Rotational symmetry
4. Understand and apply the concepts of congruence and symmetry (line and rotational).	
5. Compare properties of cylinders, prisms, cones, pyramids, and spheres.	Cylinders, cones and spheres Solid shapes
6. Identify, describe, and draw the faces or shadows (projections) of three-dimensional geometric objects from different perspectives.	Views of 3D shapes
7. Identify a three-dimensional shape with given projections (top, front and side views).	Views of 3D shapes
8. Identify a three-dimensional shape with a given net (i.e., a flat pattern that folds into a 3D shape).	Nets
4.2.6 B. Transforming Shapes	
	Translation Reflection Rotation Combining transformations
1. Use a translation, a reflection, or a rotation to map one figure onto another congruent figure.	
2. Recognize, identify, and describe geometric relationships and properties as they exist in nature, art, and other real-world settings.	-
4.2.6 C. Coordinate Geometry	
1. Create geometric shapes with specified properties in the first quadrant on a coordinate grid.	Quadrilaterals on a coordinate grid
4.2.6 D. Units of Measurement	
	Measuring angles Area Surface area Volume
1. Select and use appropriate units to measure angles, area, surface area, and volume.	
2. Use a scale to find a distance on a map or a length on a scale drawing.	Scale drawings

3. Convert measurement units within a system (e.g., 3 feet = ___ inches).	Customary unit conversions Converting metric units
4. Know approximate equivalents between the standard and metric systems (e.g., one kilometer is approximately 6/10 of a mile).	Customary unit conversions
5. Use measurements and estimates to describe and compare phenomena.	Measuring angles Estimating measurements
4.2.6 E. Measuring Geometric Objects	
1. Use a protractor to measure angles.	Measuring angles
2. Develop and apply strategies and formulas for finding perimeter and area.	
- Triangle, square, rectangle, parallelogram, and trapezoid	Perimeter Using formulas Area Area problems
- Circumference and area of a circle	Circumference of a circle Area of a circle
3. Develop and apply strategies and formulas for finding the surface area and volume of rectangular prisms and cylinders.	Surface area Volume Cylinders, cones and spheres
4. Recognize that shapes with the same perimeter do not necessarily have the same area and vice versa.	-
5. Develop informal ways of approximating the measures of familiar objects (e.g., use a grid to approximate the area of the bottom of one's foot).	-
STANDARD 4.3 (PATTERNS AND ALGEBRA) ALL STUDENTS WILL REPRESENT AND ANALYZE RELATIONSHIPS AMONG VARIABLE QUANTITIES AND SOLVE PROBLEMS INVOLVING PATTERNS, FUNCTIONS, AND ALGEBRAIC CONCEPTS AND PROCESSES.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 6, students will:	
4.3.6 A. Patterns	
1. Recognize, describe, extend, and create patterns involving whole numbers and rational numbers.	
- Descriptions using tables, verbal rules, simple equations, and graphs	Function machines Mapping functions Graphs of functions Introducing sequences Sequences from geometrical patterns Describing and continuing sequences Generating sequences from flow charts

- Formal iterative formulas (e.g., $NEXT = NOW * 3$)	Generating sequences and rules Sequences from practical contexts Describing and continuing sequences
- Recursive patterns, including Pascal's Triangle (where each entry is the sum of the entries above it) and the Fibonacci Sequence: 1, 1, 2, 3, 5, 8, . . . (where $NEXT = NOW + PREVIOUS$)	Describing and continuing sequences
4.3.6 B. Functions and Relationships	
1. Describe the general behavior of functions given by formulas or verbal rules (e.g., graph to determine whether increasing or decreasing, linear or not).	Graphs of functions The equation of a straight line
4.3.6 C. Modeling	
1. Use patterns, relations, and linear functions to model situations.	
- Using variables to represent unknown quantities	Writing expressions
- Using concrete materials, tables, graphs, verbal rules, algebraic expressions/equations/inequalities	Sequences from practical contexts Mapping functions Graphs of functions Solving linear inequalities
2. Draw freehand sketches of graphs that model real phenomena and use such graphs to predict and interpret events.	
- Changes over time	Interpreting graphs Distance-time graphs
- Relations between quantities	Interpreting graphs Conversion graphs
- Rates of change (e.g., when is plant growing slowly/rapidly, when is temperature dropping most rapidly/slowly)	Interpreting graphs Distance-time graphs
4.3.6 D. Procedures	
1. Solve simple linear equations with manipulatives and informally.	
- Whole-number coefficients only, answers also whole numbers	Solving simple equations Substitution Introducing formulas
- Variables on one or both sides of equation	Equations with variables on both sides
2. Understand and apply the properties of operations and numbers.	
- Distributive property	Properties of numbers
- The product of a number and its reciprocal is 1	-

	Substitution Adding and subtracting integers Adding and subtracting integers activities Multiplying and dividing integers Mental addition and subtraction Mental multiplication Mental division Order of operations and PEMDAS Written methods for addition and subtraction Written methods for multiplication Written methods for division
3. Evaluate numerical expressions.	
4. Extend understanding and use of inequality.	
- Symbols (\geq , \neq , \leq)	Inequalities
STANDARD 4.4 (DATA ANALYSIS, PROBABILITY, AND DISCRETE MATHEMATICS) ALL STUDENTS WILL DEVELOP AN UNDERSTANDING OF THE CONCEPTS AND TECHNIQUES OF DATA ANALYSIS, PROBABILITY, AND DISCRETE MATHEMATICS, AND WILL USE THEM TO MODEL SITUATIONS, SOLVE PROBLEMS, AND ANALYZE AND DRAW APPROPRIATE INFERENCES FROM DATA.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 6, students will:	
4.4.6 A. Data Analysis	
1. Collect, generate, organize, and display data.	
- Data generated from surveys	Population and sampling Collecting data Organizing data
2. Read, interpret, select, construct, analyze, generate questions about, and draw inferences from displays of data.	
- Bar graph, line graph, circle graph, table, histogram	Bar graphs Line graphs Circle graphs Collecting data Histograms
- Range, median, and mean	Finding the range Finding the median Calculating the mean
- Calculators and computers used to record and process information	Using a calculator
3. Respond to questions about data, generate their own questions and hypotheses, and formulate strategies for answering their questions and testing their hypotheses.	Writing a statistical report Comparing data

4.4.6 B. Probability	
1. Determine probabilities of events.	
- Event, complementary event, probability of an event	Calculating probability part 1 Calculating probability part 2 The language of probability
- Multiplication rule for probabilities	Probability diagrams
- Probability of certain event is 1 and of impossible event is 0	The probability scale
- Probabilities of event and complementary event add up to 1	Calculating probability part 2
2. Determine probability using intuitive, experimental, and theoretical methods (e.g., using model of picking items of different colors from a bag).	
- Given numbers of various types of items in a bag, what is the probability that an item of one type will be picked	Calculating probability part 1
- Given data obtained experimentally, what is the likely distribution of items in the bag	Experimental probability
3. Explore compound events.	Probability diagrams
4. Model situations involving probability using simulations (with spinners, dice) and theoretical models.	Experimental probability
5. Recognize and understand the connections among the concepts of independent outcomes, picking at random, and fairness.	The language of probability
4.4.6 C. Discrete Mathematics—Systematic Listing and Counting	
1. Solve counting problems and justify that all possibilities have been enumerated without duplication.	
- Organized lists, charts, tree diagrams, tables	Probability diagrams
- Venn diagrams	Venn diagrams
2. Apply the multiplication principle of counting.	
- Simple situations (e.g., you can make $3 \times 4 = 12$ outfits using 3 shirts and 4 skirts).	Probability diagrams
- Number of ways a specified number of items can be arranged in order (concept of permutation)	-
- Number of ways of selecting a slate of officers from a class (e.g., if there are 23 students and 3 officers, the number is $23 \times 22 \times 21$)	-
3. List the possible combinations of two elements chosen from a given set (e.g., forming a committee of two from a group of 12 students, finding how many handshakes there will be among ten people if everyone shakes each other person's hand once).	Probability diagrams
4.4.6 D. Discrete Mathematics—Vertex-Edge Graphs and Algorithms	
1. Devise strategies for winning simple games (e.g., start with two piles of objects, each of two players in turn removes any number of objects from a single pile, and the person to take the last group of objects wins) and express those strategies as sets of directions.	-
2. Analyze vertex-edge graphs and tree diagrams.	
- Can a picture or a vertex-edge graph be drawn with a single line? (degree of vertex)	-
- Can you get from any vertex to any other vertex? (connectedness)	-

3. Use vertex-edge graphs to find solutions to practical problems.	
- Delivery route that stops at specified sites but involves least travel	-
- Shortest route from one site on a map to another	-
Grade 7	
STANDARD 4.1 (NUMBER AND NUMERICAL OPERATIONS) ALL STUDENTS WILL DEVELOP NUMBER SENSE AND WILL PERFORM STANDARD NUMERICAL OPERATIONS AND ESTIMATIONS ON ALL TYPES OF NUMBERS IN A VARIETY OF WAYS.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 7, students will:	
4.1.7 A. Number Sense	
1. Extend understanding of the number system by constructing meanings for the following (unless otherwise noted, all indicators for grade 7 pertain to these sets of numbers as well):	
- Rational numbers	Rational and irrational numbers
- Percents	Introducing percentages
- Whole numbers with exponents	Powers
2. Demonstrate a sense of the relative magnitudes of numbers.	Absolute value Ordering decimals Ordering integers Ordering fractions Using negative numbers in context
3. Understand and use ratios, proportions, and percents (including percents greater than 100 and less than 1) in a variety of situations.	Ratio and rate Dividing in a given ratio Direct proportion Ratio and proportion problems Comparing proportions Calculating percentages mentally Calculating percentages on paper Calculating percentages with a calculator Percentages and inverse operations Percentage change
4. Compare and order numbers of all named types.	Ordering decimals Ordering integers Ordering fractions Using negative numbers in context

5. Use whole numbers, fractions, decimals, and percents to represent equivalent forms of the same number.	Equivalent fractions, decimals and percentages Equivalent fractions Introducing percentages Fractions and decimals
6. Understand that all fractions can be represented as repeating or terminating decimals.	Fractions and decimals Equivalent fractions, decimals and percentages
4.1.7 B. Numerical Operations	
1. Use and explain procedures for performing calculations with integers and all number types named above with:	
- Pencil-and-paper	Written methods for addition and subtraction Written methods for multiplication Written methods for division Calculating percentages on paper Methods for adding and subtracting fractions Multiplying fractions Dividing by fractions
- Mental math	Mental addition and subtraction Mental multiplication Mental division Mental math and place value Multiplying by numbers between 0 and 1 Mental math puzzles Calculating percentages mentally Adding and subtracting simple fractions
- Calculator	Calculating percentages with a calculator Using a calculator Methods for adding and subtracting fractions Multiplying and dividing integers
2. Use exponentiation to find whole number powers of numbers.	Powers
3. Understand and apply the standard algebraic order of operations, including appropriate use of parentheses.	Order of operations and PEMDAS
4.1.7 C. Estimation	

1. Use equivalent representations of numbers such as fractions, decimals, and percents to facilitate estimation.	Equivalent fractions, decimals and percentages Calculating percentages mentally
STANDARD 4.2 (GEOMETRY AND MEASUREMENT) ALL STUDENTS WILL DEVELOP SPATIAL SENSE AND THE ABILITY TO USE GEOMETRIC PROPERTIES, RELATIONSHIPS, AND MEASUREMENT TO MODEL, DESCRIBE AND ANALYZE PHENOMENA.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 7, students will:	
4.2.7 A. Geometric Properties	
1. Understand and apply properties of polygons.	
- Quadrilaterals, including squares, rectangles, parallelograms, trapezoids, rhombi	Quadrilaterals The sum of interior and exterior angles
- Regular polygons	Polygons The sum of interior and exterior angles Angles in polygons
2. Understand and apply the concept of similarity.	
- Using proportions to find missing measures	Finding missing lengths Using scale factors
- Scale drawings	Scale drawings
- Models of 3D objects	Solid shapes 2D representations of 3D spaces Nets Views of 3D shapes
3. Use logic and reasoning to make and support conjectures about geometric objects.	Constructing nets Nets Views of 3D shapes Solid shapes
4.2.7 B. Transforming Shapes	
1. Understand and apply transformations.	
- Finding the image, given the pre-image, and vice-versa	Reflection Rotation Translation Dilation Combining transformations
- Sequence of transformations needed to map one figure onto another	Combining transformations

- Reflections, rotations, and translations result in images congruent to the pre-image	Reflection Rotation Translation
- Dilations (stretching/shrinking) result in images similar to the pre-image	Dilation
4.2.7 C. Coordinate Geometry	
1. Use coordinates in four quadrants to represent geometric concepts.	Introducing coordinates Quadrilaterals on a coordinate grid
2. Use a coordinate grid to model and quantify transformations (e.g., translate right 4 units).	Reflection Rotation Translation Dilation Combining transformations
4.2.7 D. Units of Measurement	
1. Solve problems requiring calculations that involve different units of measurement within a measurement system (e.g., 4'3" plus 7'10" equals 12'1").	Converting metric units Customary unit conversions
2. Select and use appropriate units and tools to measure quantities to the degree of precision needed in a particular problem-solving situation.	Reading scales Measuring angles
3. Recognize that all measurements of continuous quantities are approximations.	-
4.2.7 E. Measuring Geometric Objects	
1. Develop and apply strategies for finding perimeter and area.	
- Geometric figures made by combining triangles, rectangles and circles or parts of circles	Perimeter Area Area of irregular shapes Area problems Circumference of a circle Area of a circle
- Estimation of area using grids of various sizes	-
2. Recognize that the volume of a pyramid or cone is one-third of the volume of the prism or cylinder with the same base and height (e.g., use rice to compare volumes of figures with same base and height).	Cylinders, cones and spheres
STANDARD 4.3 (PATTERNS AND ALGEBRA) ALL STUDENTS WILL REPRESENT AND ANALYZE RELATIONSHIPS AMONG VARIABLE QUANTITIES AND SOLVE PROBLEMS INVOLVING PATTERNS, FUNCTIONS, AND ALGEBRAIC CONCEPTS AND PROCESSES.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 7, students will:	
4.3.7 A. Patterns	
1. Recognize, describe, extend, and create patterns involving whole numbers, rational numbers, and integers.	

	Function machines Mapping functions Graphs of functions Introducing sequences Sequences from geometrical patterns Describing and continuing sequences Generating sequences from flow charts Generating sequences and rules
- Descriptions using tables, verbal and symbolic rules, graphs, simple equations or expressions	
- Finite and infinite sequences	Introducing sequences
- Generating sequences by using calculators to repeatedly apply a formula	-
4.3.7 B. Functions and Relationships	
1. Graph functions, and understand and describe their general behavior.	
	Direct variations Graphs of functions The equation of a straight line
- Equations involving two variables	
4.3.7 C. Modeling	
1. Analyze functional relationships to explain how a change in one quantity can result in a change in another, using pictures, graphs, charts, and equations.	Direct variations Graphs of functions The equation of a straight line
2. Use patterns, relations, symbolic algebra, and linear functions to model situations.	
	Sequences from practical contexts Mapping functions Graphs of functions Solving linear inequalities
- Using manipulatives, tables, graphs, verbal rules, algebraic expressions/equations/inequalities	
- Growth situations, such as population growth and compound interest, using recursive (e.g., NOW-NEXT) formulas (cf. science standard 5.5 and social studies standard 6.6)	-
4.3.7 D. Procedures	
1. Use graphing techniques on a number line.	
- Absolute value	Absolute value
- Arithmetic operations represented by vectors (arrows) (e.g., “-3 + 6” is “left 3, right 6”)	-
2. Solve simple linear equations informally and graphically.	

- Multi-step, integer coefficients only (although answers may not be integers)	Solving simple equations Combining like terms Multiplying algebraic terms Dividing algebraic terms Graphs of functions The equation of a straight line Equations involving parentheses and division Equations with variables on both sides
- Using paper-and-pencil, calculators, graphing calculators, spreadsheets, and other technology	Solving simple equations Graphs of functions The equation of a straight line
3. Create, evaluate, and simplify algebraic expressions involving variables.	
- Order of operations, including appropriate use of parentheses	Order of operations and PEMDAS
- Substitution of a number for a variable	Substitution
4. Understand and apply the properties of operations, numbers, equations, and inequalities.	
- Additive inverse	Solving simple equations
- Multiplicative inverse	Solving simple equations
STANDARD 4.4 (DATA ANALYSIS, PROBABILITY, AND DISCRETE MATHEMATICS) ALL STUDENTS WILL DEVELOP AN UNDERSTANDING OF THE CONCEPTS AND TECHNIQUES OF DATA ANALYSIS, PROBABILITY, AND DISCRETE MATHEMATICS, AND WILL USE THEM TO MODEL SITUATIONS, SOLVE PROBLEMS, AND ANALYZE AND DRAW APPROPRIATE INFERENCES FROM DATA.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 7, students will:	
4.4.7 A. Data Analysis	
1. Select and use appropriate representations for sets of data, and measures of central tendency (mean, median, and mode).	
- Type of display most appropriate for given data	Appropriate graphs Bar graphs Circle graphs Line graphs Histograms Quartiles and box plots
- Box-and-whisker plot, upper quartile, lower quartile	Quartiles and box plots
- Scatter plot	Scatter plots
- Calculators and computer used to record and process information	Calculating the mean

	Bar graphs Circle graphs Line graphs Histograms Quartiles and box plots Finding the mode Finding the median Finding the range Calculating the mean Calculating statistics
2. Make inferences and formulate and evaluate arguments based on displays and analysis of data.	
4.4.7 B. Probability	
1. Interpret probabilities as ratios, percents, and decimals.	The probability scale Calculating probability part 1
2. Model situations involving probability with simulations (using spinners, dice, calculators and computers) and theoretical models.	
- Frequency, relative frequency	Experimental probability
	Experimental probability Calculating probability part 1 Calculating probability part 2
3. Estimate probabilities and make predictions based on experimental and theoretical probabilities.	
4. Play and analyze probability-based games, and discuss the concepts of fairness and expected value.	The language of probability
4.4.7 C. Discrete Mathematics—Systematic Listing and Counting	
1. Apply the multiplication principle of counting.	
- Permutations: ordered situations with replacement (e.g., number of possible license plates) vs. ordered situations without replacement (e.g., number of possible slates of 3 class officers from a 23 student class)	-
2. Explore counting problems involving Venn diagrams with three attributes (e.g., there are 15, 20, and 25 students respectively in the chess club, the debating team, and the engineering society; how many different students belong to the three clubs if there are 6 students in chess and debating, 7 students in chess and engineering, 8 students in debating and engineering, and 2 students in all three?).	Venn diagrams
3. Apply techniques of systematic listing, counting, and reasoning in a variety of different contexts	Probability diagrams
4.4.7 D. Discrete Mathematics—Vertex-Edge Graphs and Algorithms	
1. Use vertex-edge graphs to represent and find solutions to practical problems.	
- Finding the shortest network connecting specified sites	-
- Finding the shortest route on a map from one site to another	-
- Finding the shortest circuit on a map that makes a tour of specified sites	-

Grade 8	
STANDARD 4.1 (NUMBER AND NUMERICAL OPERATIONS) ALL STUDENTS WILL DEVELOP NUMBER SENSE AND WILL PERFORM STANDARD NUMERICAL OPERATIONS AND ESTIMATIONS ON ALL TYPES OF NUMBERS IN A VARIETY OF WAYS.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 8, students will:	
4.1.8 A. Number Sense	
1. Extend understanding of the number system by constructing meanings for the following (unless otherwise noted, all indicators for grade 8 pertain to these sets of numbers as well):	
- Rational numbers	Rational and irrational numbers
- Percents	Introducing percentages
- Exponents	Powers
- Roots	Square roots Cubes and cube roots
- Absolute values	Absolute value
- Numbers represented in scientific notation	Scientific notation
2. Demonstrate a sense of the relative magnitudes of numbers.	Ordering decimals Ordering integers Ordering fractions Using negative numbers in context Absolute value
3. Understand and use ratios, rates, proportions, and percents (including percents greater than 100 and less than 1) in a variety of situations.	Ratio and rate Comparing proportions Dividing in a given ratio Direct proportion Ratio and proportion problems Introducing percentages Percentage change Percentages and inverse operations Calculating percentages mentally Calculating percentages on paper Calculating percentages with a calculator

4. Compare and order numbers of all named types	Ordering decimals Ordering integers Ordering fractions Using negative numbers in context Absolute value Scientific notation Square roots Cubes and cube roots
5. Use whole numbers, fractions, decimals, and percents to represent equivalent forms of the same number.	Equivalent fractions, decimals and percentages Equivalent fractions Introducing percentages Fractions and decimals
6. Recognize that repeating decimals correspond to fractions and determine their fractional equivalents.	
- $5/7 = 0.714285714285... = 0.714285$	Fractions and decimals
7. Construct meanings for common irrational numbers, such as π (pi) and the square root of 2.	Circumference of a circle
4.1.8 B. Numerical Operations	
1. Use and explain procedures for performing calculations involving addition, subtraction, multiplication, division, and exponentiation with integers and all number types named above with:	
- Pencil-and-paper	Written methods for addition and subtraction Written methods for multiplication Written methods for division Calculating percentages on paper Methods for adding and subtracting fractions Multiplying fractions Dividing by fractions
- Mental math	Mental addition and subtraction Mental multiplication Mental division Mental math and place value Multiplying by numbers between 0 and 1 Mental math puzzles Calculating percentages mentally Adding and subtracting simple fractions Square roots

- Calculator	Calculating percentages with a calculator Using a calculator Methods for adding and subtracting fractions Multiplying and dividing integers Square roots Powers
2. Use exponentiation to find whole number powers of numbers.	Powers
3. Find square and cube roots of numbers and understand the inverse nature of powers and roots.	Square roots Cubes and cube roots
4. Solve problems involving proportions and percents.	Comparing proportions Dividing in a given ratio Direct proportion Ratio and proportion problems Introducing percentages Percentage change Percentages and inverse operations Calculating percentages mentally Calculating percentages on paper Calculating percentages with a calculator
5. Understand and apply the standard algebraic order of operations, including appropriate use of parentheses.	Order of operations and PEMDAS
4.1.8 C. Estimation	
1. Estimate square and cube roots of numbers.	Square roots Cubes and cube roots Estimation and approximation
2. Use equivalent representations of numbers such as fractions, decimals, and percents to facilitate estimation.	Equivalent fractions, decimals and percentages Equivalent fractions Introducing percentages Fractions and decimals
3. Recognize the limitations of estimation and assess the amount of error resulting from estimation.	-

STANDARD 4.2 (GEOMETRY AND MEASUREMENT) ALL STUDENTS WILL DEVELOP SPATIAL SENSE AND THE ABILITY TO USE GEOMETRIC PROPERTIES, RELATIONSHIPS, AND MEASUREMENT TO MODEL, DESCRIBE AND ANALYZE PHENOMENA.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 8, students will:	
4.2.8 A. Geometric Properties	
1. Understand and apply concepts involving lines, angles, and planes.	
- Complementary and supplementary angles	Calculating angles
- Vertical angles	Calculating angles
- Bisectors and perpendicular bisectors	Constructing lines and angles
- Parallel, perpendicular, and intersecting planes	Parallel and perpendicular lines Angles made with parallel lines
- Intersection of plane with cube, cylinder, cone, and sphere	-
2. Understand and apply the Pythagorean theorem.	Pythagorean theorem Identifying right triangles Pythagorean triples Calculating sides of right triangles
3. Understand and apply properties of polygons.	
- Quadrilaterals, including squares, rectangles, parallelograms, trapezoids, rhombi	Quadrilaterals
- Regular polygons	Polygons Angles in polygons Triangles Angles in a triangle
- Sum of measures of interior angles of a polygon	The sum of interior and exterior angles
- Which polygons can be used alone to generate a tessellation and why	Tessellations
4. Understand and apply the concept of similarity.	
- Using proportions to find missing measures	Finding missing lengths Congruence
- Scale drawings	Scale drawings
- Models of 3D objects	Views of 3D shapes Solid shapes Nets 2-D representations of 3-D shapes
5. Use logic and reasoning to make and support conjectures about geometric objects.	Views of 3D shapes Solid shapes 2D representations of 3D shapes Nets

6. Perform basic geometric constructions using a variety of methods (e.g., straightedge and compass, patty/tracing paper, or technology).	
- Congruent angles or line segments	Drawing lines and angles Constructing lines and angles
- Midpoint of a line segment	Finding the midpoint of a line segment Constructing lines and angles
7. Create two-dimensional representations (e.g., nets or projective views) for the surfaces of three-dimensional objects.	2D representations of 3D spaces Nets Constructing nets Views of 3-D shapes
4.2.8 B. Transforming Shapes	
1. Understand and apply transformations.	
- Finding the image, given the pre-image, and vice-versa	Reflection Rotation Translation Dilation Combining transformations
- Sequence of transformations needed to map one figure onto another	Combining transformations
- Reflections, rotations, and translations result in images congruent to the pre-image	Reflection Rotation Translation
- Dilations (stretching/shrinking) result in images similar to the pre-image	Dilation
2. Use iterative procedures to generate geometric patterns.	
- Fractals (e.g., the Koch Snowflake)	-
- Self-similarity	-
- Construction of initial stages	-
- Patterns in successive stages (e.g., number of triangles in each stage of Sierpinski's Triangle)	-
4.2.8 C. Coordinate Geometry	
1. Use coordinates in four quadrants to represent geometric concepts.	Introducing coordinates Quadrilaterals on a coordinate grid
2. Use a coordinate grid to model and quantify transformations (e.g., translate right 4 units).	Reflection Rotation Translation Dilation Combining transformations
4.2.8 D. Units of Measurement	

1. Solve problems requiring calculations that involve different units of measurement within a measurement system (e.g., 4'3" plus 7'10" equals 12'1").	Converting metric units Customary unit conversions
2. Use approximate equivalents between standard and metric systems to estimate measurements (e.g., 5 kilometers is about 3 miles).	Customary unit conversions
3. Recognize that the degree of precision needed in calculations depends on how the results will be used and the instruments used to generate the measurements.	Rounding
4. Select and use appropriate units and tools to measure quantities to the degree of precision needed in a particular problem-solving situation.	Converting metric units Customary unit conversions
5. Recognize that all measurements of continuous quantities are approximations.	-
6. Solve problems that involve compound measurement units, such as speed (miles per hour), air pressure (pounds per square inch), and population density (persons per square mile).	-
4.2.8 E. Measuring Geometric Objects	
1. Develop and apply strategies for finding perimeter and area.	
	Perimeter Circumference of a circle Area of a circle Area Area of irregular shapes Area problems Using formulas
- Geometric figures made by combining triangles, rectangles and circles or parts of circles	
- Estimation of area using grids of various sizes	-
- Impact of a dilation on the perimeter and area of a 2-dimensional figure	-
2. Recognize that the volume of a pyramid or cone is one-third of the volume of the prism or cylinder with the same base and height (e.g., use rice to compare volumes of figures with same base and height).	Cylinders, cones and spheres
3. Develop and apply strategies and formulas for finding the surface area and volume of a three-dimensional figure.	
	Volume Cylinders, cones and spheres Formulas for shapes
- Volume - prism, cone, pyramid	
- Surface area - prism (triangular or rectangular base), pyramid (triangular or rectangular base)	Surface area Formulas for shapes
- Impact of a dilation on the surface area and volume of a three-dimensional figure	-
4. Use formulas to find the volume and surface area of a sphere.	
	Cylinders, cones and spheres Formulas for shapes

STANDARD 4.3 (PATTERNS AND ALGEBRA) ALL STUDENTS WILL REPRESENT AND ANALYZE RELATIONSHIPS AMONG VARIABLE QUANTITIES AND SOLVE PROBLEMS INVOLVING PATTERNS, FUNCTIONS, AND ALGEBRAIC CONCEPTS AND PROCESSES.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 8, students will:	
4.3.8 A. Patterns	
1. Recognize, describe, extend, and create patterns involving whole numbers, rational numbers, and integers.	
	Function machines Mapping functions Graphs of functions Introducing sequences Sequences from geometrical patterns Describing and continuing sequences Generating sequences from flow charts
- Descriptions using tables, verbal and symbolic rules, graphs, simple equations or expressions	
- Finite and infinite sequences	Introducing sequences
- Arithmetic sequences (i.e., sequences generated by repeated addition of a fixed number, positive or negative)	Describing and continuing sequences
- Geometric sequences (i.e., sequences generated by repeated multiplication by a fixed positive ratio, greater than 1 or less than 1)	Describing and continuing sequences
- Generating sequences by using calculators to repeatedly apply a formula	-
4.3.8 B. Functions and Relationships	
1. Graph functions, and understand and describe their general behavior.	
	Direct variations Graphs of functions The equation of a straight line
- Equations involving two variables	
- Rates of change (informal notion of slope)	Distance-time graphs
2. Recognize and describe the difference between linear and exponential growth, using tables, graphs, and equations.	Graphs of functions The equation of a straight line Exploring nonlinear graphs
4.3.8 C. Modeling	
1. Analyze functional relationships to explain how a change in one quantity can result in a change in another, using pictures, graphs, charts, and equations.	Function machines Graphs of functions Mapping functions
2. Use patterns, relations, symbolic algebra, and linear functions to model situations.	

- Using concrete materials (manipulatives), tables, graphs, verbal rules, algebraic expressions/equations/inequalities	Sequences from practical contexts Mapping functions Graphs of functions Solving linear inequalities
- Growth situations, such as population growth and compound interest, using recursive (e.g., NOW-NEXT) formulas (cf. science standard 5.5 and social studies standard 6.6)	-
4.3.8 D. Procedures	
1. Use graphing techniques on a number line.	
- Absolute value	Absolute value
- Arithmetic operations represented by vectors (arrows) (e.g., “-3 + 6” is “left 3, right 6”)	-
2. Solve simple linear equations informally, graphically, and using formal algebraic methods.	
- Multi-step, integer coefficients only (although answers may not be integers)	Solving simple equations Combining like terms Multiplying algebraic terms Dividing algebraic terms Graphs of functions The equation of a straight line Equations involving parentheses and division Equations with variables on both sides
- Simple literal equations (e.g., $A = lw$)	Introducing formulas Using formulas
- Using paper-and-pencil, calculators, graphing calculators, spreadsheets, and other technology	Solving simple equations Combining like terms Multiplying algebraic terms Dividing algebraic terms Graphs of functions The equation of a straight line Equations involving parentheses and division Equations with variables on both sides
3. Solve simple linear inequalities.	Integer solutions for inequalities Solving linear inequalities
4. Create, evaluate, and simplify algebraic expressions involving variables.	
- Order of operations, including appropriate use of parentheses	Order of operations and PEMDAS
- Distributive property	Properties of numbers
- Substitution of a number for a variable	Substitution

- Translation of a verbal phrase or sentence into an algebraic expression, equation, or inequality, and vice versa	Writing expressions Inequalities on a number line Solving linear inequalities
5. Understand and apply the properties of operations, numbers, equations, and inequalities.	
- Additive inverse	Solving simple equations
- Multiplicative inverse	Solving simple equations
- Addition and multiplication properties of equality	Solving simple equations
- Addition and multiplication properties of inequalities	Solving linear inequalities
STANDARD 4.4 (DATA ANALYSIS, PROBABILITY, AND DISCRETE MATHEMATICS) ALL STUDENTS WILL DEVELOP AN UNDERSTANDING OF THE CONCEPTS AND TECHNIQUES OF DATA ANALYSIS, PROBABILITY, AND DISCRETE MATHEMATICS, AND WILL USE THEM TO MODEL SITUATIONS, SOLVE PROBLEMS, AND ANALYZE AND DRAW APPROPRIATE INFERENCES FROM DATA.	
Building upon knowledge and skills gained in preceding grades, by the end of Grade 8, students will:	
4.4.8 A. Data Analysis	
1. Select and use appropriate representations for sets of data, and measures of central tendency (mean, median, and mode).	
- Type of display most appropriate for given data	Appropriate graphs
- Box-and-whisker plot, upper quartile, lower quartile	Quartiles and box plots Interquartile range
- Scatter plot	Scatter plots
- Calculators and computer used to record and process information	Using a calculator
- Finding the median and mean (weighted average) using frequency data.	Finding the median Calculating the mean
- Effect of additional data on measures of central tendency	Calculating statistics
2. Make inferences and formulate and evaluate arguments based on displays and analysis of data sets.	Writing a statistical report Interpreting graphs Appropriate graphs
3. Estimate lines of best fit and use them to interpolate within the range of the data.	Scatter plots
4. Use surveys and sampling techniques to generate data and draw conclusions about large groups.	Population and sampling Collecting data Writing a statistical report
4.4.8 B. Probability	
1. Interpret probabilities as ratios, percents, and decimals.	The probability scale Calculating probability part 1
2. Determine probabilities of compound events.	Calculating probability part 1 Probability diagrams

3. Explore the probabilities of conditional events (e.g., if there are seven marbles in a bag, three red and four green, what is the probability that two marbles picked from the bag, without replacement, are both red).	-
4. Model situations involving probability with simulations (using spinners, dice, calculators and computers) and theoretical models.	
- Frequency, relative frequency	Experimental probability
5. Estimate probabilities and make predictions based on experimental and theoretical probabilities.	Experimental probability The language of probability Calculating probability part 1
6. Play and analyze probability-based games, and discuss the concepts of fairness and expected value.	The language of probability
4.4.8 C. Discrete Mathematics—Systematic Listing and Counting	
1. Apply the multiplication principle of counting.	
- Permutations: ordered situations with replacement (e.g., number of possible license plates) vs. ordered situations without replacement (e.g., number of possible slates of 3 class officers from a 23 student class)	-
- Factorial notation	-
- Concept of combinations (e.g., number of possible delegations of 3 out of 23 students)	-
2. Explore counting problems involving Venn diagrams with three attributes (e.g., there are 15, 20, and 25 students respectively in the chess club, the debating team, and the engineering society; how many different students belong to the three clubs if there are 6 students in chess and debating, 7 students in chess and engineering, 8 students in debating and engineering, and 2 students in all three?).	Venn diagrams
3. Apply techniques of systematic listing, counting, and reasoning in a variety of different contexts.	Probability diagrams
4.4.8 D. Discrete Mathematics—Vertex-Edge Graphs and Algorithms	
1. Use vertex-edge graphs and algorithmic thinking to represent and find solutions to practical problems.	
- Finding the shortest network connecting specified sites	-
- Finding a minimal route that includes every street (e.g., for trash pick-up)	-
- Finding the shortest route on a map from one site to another	-
- Finding the shortest circuit on a map that makes a tour of specified sites	-
- Limitations of computers (e.g., the number of routes for a delivery truck visiting n sites is $n!$, so finding the shortest circuit by examining all circuits would overwhelm the capacity of any computer, now or in the future, even if n is less than 100)	-