8th Grade Math
Scope and Sequence
Fundamentals of Algebra
(Aligned to eMath Instruction)

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Fundamentals of Algebra

PACING GUIDE

Quarter 1:	Unit 1	8 Lessons	Tools of Geometry
	Unit 2	12 Lessons	Transformations
	Total: 20 Lessons		
Quarter 2:	Unit 3	9 Lessons	Similarity and Dilations
	Unit 4	10 Lessons	The Algebra of One Variable
	Total:	**19 Lessons**	
Quarter 3:	Unit 5	9 Lessons	Equations of Lines
	Unit 6	9 Lessons	Functions
	Unit 10	5 Lessons	Scientific Notation
	Total:	**23 Lessons**	
Quarter 4:	Unit 7	8 Lessons	Exponents and Roots
	Unit 8	5 Lessons	Pythagorean Theorem
	Unit 9	6 Lessons	Functions
	Unit 11	4 Lessons	Systems of Equations
	Total:	**23 Lessons**	

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Quarter 1

Unit 1 – Tools of Geometry

1. Starting Concepts in Geometry
2. Angles and Their Measures
3. Angle Pairs
4. Geometric Terminology
5. Parallel Lines
6. Geometry with Coordinates
7. Congruent Geometric Objects
8. Congruent Triangles

Unit 2 - Transformations (supplement with IXL:B,C)

1. Introduction to Transformations
2. Reflections
3. Horizontal and Vertical Lines in Coordinate Plane
4. Reflections in the Coordinate Plane
5. Rotations
6. Rotations in the Coordinate Plane
7. Translations
8. Translations in the Coordinate Plane
9. Transformations and Congruent Figures
10. Angle Sums in a Triangle
11. Exterior Angles of a Triangle
12. Isosceles Triangles

Quarterly Exam # 1

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Quarter 2

Unit 3 – Similarity and Dilations (Supplement with IXL: J,K)

1. Proportional Variables
2. Introduction to Dilations
3. More Work with Dilations
4. Dilations in the Coordinate Plane
5. Similar Figures
6. More Worok with Similar Figures
7. Mapping Similarity
8. The Angle-Angle Criterion for Similar Triangles
9. Similar Triangles and Parallel Lines

Unit 4 – The Algebra of One Variable (Supplement with IXL: L,M)

1. Operations with Signed Numbers
2. Variables and Expressions
3. Combining Like Terms
4. Solving Two-Step Equations
5. More Work with Two-Step Equations
6. Solving Equations with Variables on Both Sides
7. More Work with Variables on Both Sides
8. Modelling with Linear Equations
9. More Modeling with Linear Equations
10. Identities and Inconsistent Equations

Quarterly Exam # 2

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Quarter 3

Unit 5 – Equations of Lines (Supplement with IXL: CC)

1. Proportional Relationships
2. Slope and Similarity
3. Equations of Lines
4. Slopes and negative Numbers
5. More Work with Equations of Lines
6. Finding the Slope of a Line
7. Systems of Equations
8. Solving Systems Algebraically
9. Parallel Lines in the Coordinate Plane

Unit 6 – Functions (Supplement with IXL: R)

1. Introduction to Functions
2. Features of Functions
3. Average Rate of Change
4. Linear Functions
5. More Work with Linear Functions
6. Non-Linear Functions
7. Scatter Plots and Lines of Best Fit
8. More Work with Lines of Best Fit
9. The Strength of a Linear Fit

Unit 10 – Scientific Notation

1. Multiplying by Powers of 10
2. Scientific Notation
3. Operations with Numbers in Scientific Notation

4. Scientific Notation on the Calculator
5. Applications of Scientific Notation

Quarterly Exam # 3

Quarter 4

Unit 7 – Exponents and Roots (Supplement with IXL: DD)

1. Exponents
2. More Properties of Exponents
3. Simplifying Fractions
4. Negative and Zero Exponents
5. Exponent Practice
6. Square Roots
7. More Work with Square Roots
8. Cube Roots

Unit 8 – The Pythagorean Theorem (Supplement with IXL: W)

1. The Pythagorean Theorem
2. The Pythagorean Theorem and Its Converse
3. Applying the Pythagorean Theorem
4. Distance in the Coordinate Plane
5. Understanding the Pythagorean Theorem

Unit 9 – Volume and Surface Area (Supplement with IXL: AA)

1. Volume and Surface Area of Prisms
2. The Circumference and Area of a Circle
3. Cylinders and Their Volumes
4. The Surface Area of a Cylinder
5. Cones and Their Volumes
6. Spheres

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Unit 11 – Systems of Equations

1. Systems of Equations (Revisited)
2. Solving Systems by Substitution
3. Solving Systems by Elimination
4. Modeling with Systems of Equations

Quarterly Exam #4

Standards Addressed in Fundamentals of Algebra

Grade 8 Overview

In Grade 8, instructional time should focus on three areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem. Please note that while every standard/topic in the grade level has not been included in this overview, all standards should be included in instruction.

1. Through their learning in the ***Number System***, the ***Expressions, Equations, and Inequalities***, and the ***Probability and Statistics*** domains, students:
   - recognize equations for proportions (y/x = m or y = mx) as special linear equations (y = mx + b), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin;
   - understand that the slope (m) of a line is a constant rate of change, as well as how the input and output change as a result of the constant rate of change;
   - interpret a model in the context of the data by expressing a linear relationship between the two quantities in question and interpret components of the relationship (such as slope and y-intercept) in terms of the situation;
   - solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line; and
   - use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to represent, analyze, and solve a variety of problems.

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2. Through their learning in the ***Functions*** and the ***Expressions, Equations, and Inequalities*** domains, students:
   - grasp the concept of a function as a rule that assigns to each input exactly one output;
   - understand that functions describe situations where one quantity determines another; and
   - translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations of the function), and describe how aspects of the function are reflected in the different representations.

3. Through their learning in the ***Geometry*** domain, students:
   - use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems;
   - show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines;
   - understand the statement of the Pythagorean Theorem and its converse, and why the Pythagorean Theorem holds; and
   - apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons.

Mathematical Practices

1. Make sense of problems and persevere in solving them.	5. Use appropriate tools strategically.
2. Reason abstractly and quantitatively.	6. Attend to precision.
3. Construct viable arguments and critique the reasoning of others.	7. Look for and make use of structure.
4. Model with mathematics.	8. Look for and express regularity in repeated reasoning.

NY-8.NS	The Number System	
Know that there are numbers that are not rational, and approximate them by rational numbers.		
1. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion eventually repeats. Know that other numbers that are not rational are called irrational.		Coherence: NY-7.NS.2 → NY-8.NS.1 → AI-N.RN.3
2. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line, and estimate the value of expressions.		

Within-Grade Connections:

- Work with the number system in this grade (NY-8.NS.1 & 2) is intimately related to work with radicals (NY-8.EE.2), and both of these may be connected to the Pythagorean theorem (NY-8.G.6 – 8) as well as to volume problems (NY-8.G.9), e.g., in which a cube has known volume but unknown edge lengths.[14] Irrational numbers, radicals, the Pythagorean Theorem, and volume are nonlinear in nature.

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NY-8.EE	Expressions, Equations, and Inequalities	
Work with radicals and integer exponents.		
1.	Know and apply the properties of integer exponents to generate equivalent numerical expressions.	Coherence: NY-8.EE.1 → AI-A.SSE.2 e.g., $3^2 \times 3^{(-5)} = 3^{(-3)} = \frac{1}{3^3} = \frac{1}{27}$
2.	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Know square roots of perfect squares up to 225 and cube roots of perfect cubes up to 125. Know that the square root of a non-perfect square is irrational.	Coherence: NY-8.EE.2 → AI-A.REI.4 e.g., The $\sqrt{2}$ is irrational.
3.	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.	e.g., Estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.
4.	Perform multiplication and division with numbers expressed in scientific notation, including problems where both standard decimal form and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. Interpret scientific notation that has been generated by technology.	Coherence: NY-8.EE.4 → AI-N.Q.3

Connecting the Standards for Mathematical Practice to Mathematical Content:

- Scientific notation (NY-8.EE.4) presents opportunities for strategically using appropriate tools (MP.5). For example, the computation $(1.73 \times 10^{-4}) \cdot (1.73 \times 10^{-5})$ can be done quickly with a calculator by squaring 1.73 and then using properties of exponents to determine the exponent of the product by inspection.[(14)]

NY-8.EE	Expressions, Equations, and Inequalities
Understand the connections between proportional relationships, lines, and linear equations.	

5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.	Coherence: NY-7.RP.2c → NY-8.EE.5 e.g., Compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
6. Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at *b*.	Coherence: NY-7.RP.2b → NY-8.EE.6 → AI-A.REI.10 GEO-G.GPE.5

NY-8.EE	Expressions, Equations, and Inequalities
Analyze and solve linear equations and pairs of simultaneous linear equations.	
7. Solve linear equations in one variable.	Coherence: NY-7.EE.1, NY-7.EE.4a → NY-8.EE.7 → AI-A.REI.3
a. Recognize when linear equations in one variable have one solution, infinitely many solutions, or no solutions. Give examples and show which of these possibilities is the case by successively transforming the given equation into simpler forms.	
b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and combining like terms.	Note: This includes equations that contain variables on both sides of the equation.
8. Analyze and solve pairs of simultaneous linear equations.	Coherence: NY-7.EE.2 → NY-8.EE.8 → AI-A.REI.6a, AI-A.REI.7a
a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. Recognize when the system has one solution, no solution, or infinitely many solutions.	
b. Solve systems of two linear equations in two variables with integer coefficients: graphically, numerically using a table, and algebraically. Solve simple cases by inspection.	e.g., $3x + y = 5$ and $3x + y = 6$ have no solution because $3x + y$ cannot simultaneously be 5 and 6. Notes: ● Solving systems algebraically will be limited to at least one equation containing at least one variable whose coefficient is 1. Algebraic solution methods include elimination and substitution. ● This standard is a fluency expectation for grade 8.
c. Solve real-world and mathematical problems involving systems of two linear equations in two variables with integer coefficients.	Note: Solving systems algebraically will be limited to at least one equation containing at least one variable whose coefficient is 1.

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Note on *Fluency* with Procedures:

- *Fluency* with procedures *(procedural fluency)* means students are accurate, efficient, flexible, and know when and how to use them appropriately. Developing fluency requires understanding why and how a procedure works. Understanding makes learning procedures easier, less susceptible to common errors, less prone to forgetting, and easier to apply in new situations. Students also need opportunities to practice on a moderate number of carefully selected problems after they have established a strong conceptual foundation of the mathematical basis for the procedure.[12],[13]

Connecting the Standards for Mathematical Practice to Mathematical Content:

- Solving an equation such as $3(x - ½) = x + 2$ requires students to see and make use of structure (MP.7).[14]

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NY-8.F	Functions	
Define, evaluate, and compare functions. Note: Function notation is not required in Grade 8.		
1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.		Coherence: NY-8.F.1 → AI-F.IF.1, GEO-G.CO.2 Note: The terms *domain* and *range* may be introduced at this level; however, these terms are formally introduced in Algebra I (AI-F.IF.1).
2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).		Coherence: NY-7.RP.2b → NY-8.F.2 → AI-F.IF.9 e.g., Given a linear function represented by a table of values and a linear function represented by an algebraic equation, determine which function has the greater rate of change.
3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line. Recognize examples of functions that are linear and non-linear.		Coherence: NY-7.EE.4a → NY-8.F.3 → AI-F.LE.1b e.g., The function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4), and (3,9), which are not on a straight line.

NY-8.F	Functions	
Use functions to model relationships between quantities. Note: Function notation is not required in Grade 8.		
4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and		Coherence: NY-7.RP.2b → NY-8.F.4 → AI-A.CED.1, AI-F.IF.6

initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.	AI-F.BF.1
5. Describe qualitatively the functional relationship between two quantities by analyzing a graph. Sketch a graph that exhibits the qualitative features of a function that has been described in a real-world context.	Coherence: NY-7.RP.2d → NY-8.F.5 → AI-F.IF.4, AI-F.LE.3 e.g., where the function is increasing or decreasing or when the function is linear or non-linear

Connecting the Standards for Mathematical Practice to Mathematical Content:

- When students model linear relationships with functions (NY-8.F.4), they are modeling with mathematics (MP.4).[14]
- By repeatedly checking whether points are on a line through (1, 2) with slope 3, students might abstract the equation of the line in the form $(y - 2)/(x - 1) = 3$. In doing so, students look for and express regularity in repeated reasoning (MP.8).[14]

NY-8.G	Geometry
Understand congruence and similarity using physical models, transparencies, or geometry software.	
1. Verify experimentally the properties of rotations, reflections, and translations. a. Verify experimentally lines are mapped to lines, and line segments to line segments of the same length. b. Verify experimentally angles are mapped to angles of the same measure. c. Verify experimentally parallel lines are mapped to parallel lines.	Coherence: NY-8.G.1 → GEO-G.CO.2, GEO-G.CO.4 Note: A translation displaces every point in the plane by the same distance (in the same direction) and can be described using a vector. A rotation requires knowing the center/point of rotation and the measure/direction of the angle of rotation. A line reflection requires a line and the knowledge of perpendicular bisectors.
2. Know that a two-dimensional figure is congruent to another if the corresponding angles are congruent and the corresponding sides are congruent. Equivalently, two two-dimensional figures are congruent if one is the image of the other after a sequence of rotations, reflections, and translations. Given two congruent figures, describe a sequence that maps the congruence between them on the coordinate plane.	Coherence: NY-8.G.2 → GEO-G.CO.5, GEO-G.CO.6, GEO-G.CO.7
3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.	Coherence: NY-8.G.3 → GEO-G.SRT.1 Note: Lines of reflection are limited to both axes and lines of the form $y = k$ and $x = k$, where k is a constant. Rotations are limited to 90 and 180 degrees about the origin. Unless otherwise specified, rotations are assumed to be counterclockwise.
4. Know that a two-dimensional figure is similar to another if the corresponding angles are congruent and the corresponding sides are in proportion. Equivalently, two two-dimensional figures are similar if one is the image of the other after a sequence of rotations, reflections, translations, and dilations. Given two similar two-dimensional figures, describe a sequence that maps the similarity between them on the coordinate plane.	Coherence: NY-8.G.4 → GEO-G.CO.3, GEO-G.SRT.2 Note: With dilation, the center and scale factor must be specified.
5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.	Coherence: NY-7.G.5 → NY-8.G.5 → GEO-G.CO.9, GEO-G.CO.10

GEO-G.SRT.3

e.g., Arrange three copies of the same triangle so that the three angles appear to form a line, and give an argument in terms of transversals why this is so.

Note: This standard does not include formal geometric proof. Multiple representations may be used to demonstrate understanding.

Within-Grade Connections:

- An important development takes place in grade 8 when students make connections between proportional relationships, lines, and linear equations (NY-8.EE.5 & 6). The angle-angle criterion for triangle similarity underlies the fact that a nonvertical line in the coordinate plane has equation $y = mx + b$ (see page 12 of the *6-8 Progression on Expressions and Equations*). Therefore, students must do work with congruence and similarity (NY-8.G.1 – 5) before they are able to justify the connections among proportional relationships, lines, and linear equations. Hence the indicated geometry work should likely begin at or near the very start of the year.[14]

NY-8.G Geometry

Understand and apply the Pythagorean Theorem.

6. Understand a proof of the Pythagorean Theorem and its converse.

Coherence: NY-7.G.6 → NY-8.G.6

7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Coherence: NY-8.G.7 → GEO-G.SRT.8

8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Coherence: NY-8.G.8 → GEO-G.GPE.1a, GEO-G.GPE.4

Connecting the Standards for Mathematical Practice to Mathematical Content:

- The Pythagorean Theorem (NY-8.G.6 – 8) can provide opportunities for students to construct viable arguments and critique the reasoning of others (e.g., if a student in the class seems to be confusing the theorem with its converse) (MP.3).[14]

NY-8.G	Geometry
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	
9. Given the formulas for the volume of cones, cylinders, and spheres, solve mathematical and real-world problems.	Coherence: NY-7.G.4 → NY-8.G.9 → GEO-G.GMD.1 GEO-G.MG.1

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NY-8.SP	Statistics and Probability
Investigate patterns of association in bivariate data.	
1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	Coherence: NY-8.SP.1 → AI-S.ID.6, AI-S.ID.9
2. Understand that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.	Coherence: NY-8.SP.2 → AI-S.ID.6a, AI-S.ID.8
3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.	Coherence: NY-8.SP.3 → AI-S.ID.6a, AI-S.ID.7 e.g., In a linear model for a biology experiment, interpret a slope of 1.5 cm/hr. as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.

Within-Grade Connections:

- Working with scatter plots and linear models of association in bivariate measurement data (NY-8.SP.1 – 3) supports work with proportional relationships, lines, linear equations, and linear functions (NY-8.EE.5 – 8 and NY-8.F.3 & 4).[14]

Connecting the Standards for Mathematical Practice to Mathematical Content:

- Students are modeling with mathematics (MP.4) when they construct and interpret scatter plots, as well as when they use linear models to describe data (NY-8.SP.1 – 3).[14]