8th Grade Essential Learnings

Subject: Math Grade/Course: 8th Grade AG1

EL #	**Essential Learning** Benchmark (framed by Standard)	**Description Skills and Knowledge** ***(Standard Level)***	***(Additional Advanced Knowledge/Skills)***	***(Additional Highly Advanced Knowledge/Skills)***
Ex	**Learning Goal Topic (Report Card)** – NCTM Focal Points (Grade Level and/or Source Indicated if not Current Grade Level Focal Point)	Learning Progression		
1	**Solving linear equations and evaluating algebraic expressions (Algebraic expressions and linear equations)** – Students use linear functions, linear equations, and systems of linear equations to represent, analyze, and solve a variety of problems. – Students use linear equations, systems of linear equations, linear functions, and their understanding of the slope of a line to analyze situations and solve problems.	1. Foundational algebra readiness concepts review including: ● Variables in algebra ● Exponents and powers ● Order of operations ● Equations and inequalities ● Translating words into mathematical symbols ● The real number line ● Adding, subtracting, multiplying, and dividing real numbers ● The distributive property ● Combining like terms	Functions Factorials Simplifying and evaluating challenging algebraic expressions	Intro to challenging speed problems Comparisons of abstract algebraic fractions Writing, simplifying, and evaluating algebraic expressions for challenging situations.
		2. Solving and applying two step equations	Multi-step equations and problem solving exercises involving: ● Fractions ● distributing negatives ● variables on both sides	Complex problem solving situations involving multi-step equations and equations with two variables that require creativity
		3. Solving multi-step equations and equations with variables on both sides using inverse operations. Solving more complicated word problems, with an emphasis on Distance, Rate, Time problems	Complicated distance, rate, time problems	Challenging problem solving exercises involving rates
		4. Equations that have non-standard solutions ● equations with many solutions ● no solutions ● solution of zero Solving a formula for a variable	Solving and applying basic inequalities Solving for a variable where factoring is required	Solving and applying more complicated and/or abstract inequalities
		5. Applying the 4 Step problem solving process to a variety of situations: ● Translations ● consecutive integers ● rectangle geometry		

		● age problems		
2	**Analyzing patterns, relations, and functions (Patterns, relations, and functions)** − Students use linear functions, linear equations, and systems of linear equations to represent, analyze, and solve a variety of problems. − Students understand that the slope (m) of a line is a constant rate of change, so if the input, or x-coordinate, changes by a specific amount, a, the output, or y-coordinate, changes by the amount ma. − Students translate among verbal, tabular, graphical, and algebraic representations of functions (recognizing that tabular and graphical representations are usually only partial representations), and they describe how such aspects of a function as slope and y-intercept appear in different representations. − Students use linear equations, systems of linear equations, linear functions, and their understanding of the slope of a line to analyze situations and solve problems. − They apply ideas about linear functions to solve problems involving rates such as motion at a constant speed.	1. Interpreting story graphs Graphing and describing relations		
		2. Understanding what a function is and related vocabulary: ● Function ● Domain ● Range ● Input ● Output ● independent variable ● dependent variable ● input-output table Deriving the equations of functions in simple real life situations		
		3. Students continue to practice deriving equations for real life situations Interpreting graphs representing a variety of real life situations Understanding what “Slope” and “Vertical Intercepts” mean when looking at a graph	Solve problems by creating graphs of real life situations	

3	**Converting graphical, symbolic, and numerical representations of data. (The relationship between graphs and equations)** − Students use linear functions, linear equations, and systems of linear equations to represent, analyze, and solve a variety of problems. − Students understand that the slope (m) of a line is a constant rate of change, so if the input, or x-coordinate, changes by a specific amount, a, the output, or y-coordinate, changes by the amount ma. − Students translate among verbal, tabular, graphical, and algebraic representations of functions (recognizing that tabular and graphical representations are usually only partial representations), and they describe how such aspects of a function as slope and y-intercept appear in different representations. − Students use linear equations, systems of linear equations, linear functions, and their understanding of the slope of a line to analyze situations and solve problems. − Given a line in a coordinate plane, students understand that all “slope triangles”—triangles created by a vertical “rise” line segment (showing the change in y), a horizontal “run” line segment (showing the change in x),and a segment of the line itself—are similar. − They also understand the relationship of these similar triangles to the constant slope of a line. − Students make scatterplots to display bivariate data, and they informally estimate lines of best fit to make and test conjectures.	1. Make scatter plots to display bi-variate data and estimate lines of best fit to make conjectures Plot points in a coordinate plane Determine whether ordered pairs are solutions to equations Write equations in function form	Pythagorean Theorem Deriving the equation of a line from a pattern seen from a set of ordered pairs Geometric Probability	
		2. Graphing linear functions using a table of values Graphs of horizontal and vertical lines	Reflections in the coordinate plane Using a table of values to graph the following functions: ● absolute value ● parabolic	Using a table of values to graph the following functions/relations: ● step functions ● cubic functions ● hyperbolic
		3. Graphing a linear equation by finding its x and y intercepts Finding the slope of a line that passes through 2 points		Graphing inequalities
		4. Determining whether the slope of a line is positive, negative, zero, or undefined Writing and graphing equations that represent direct variations		Graphing inequalities
		5. Graphing linear equations written in slope-intercept form	Midpoint formula Reflections in the coordinate plane	Writing a linear inequality given a solution to the inequality and two points on the solution set’s boundary line.
		6. Writing equations for lines in slope-intercept form		Simple system of equations involving substitution
		7. Write equations of lines given 2 points. Given a point on a line, write the equation of a line parallel to another line		Applications of inverse functions
		8. Understand the relationship between the slopes of perpendicular lines and write the equations of perpendicular lines		

4	**Problem solving using visualization and geometric modeling (Points, lines, and planes in 2 and 3 dimensional space)** − Students use fundamental facts about distance and angles to describe and analyze figures and situations in two- and three-dimensional space and to solve problems, including those with multiple steps. − Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools (NCTM Geometry Benchmark, gr 9-12) − Use symbolic algebra to represent and explain mathematical relationships (NCTM Algebra Benchmark, gr 9-12)	1. Visualize and solve problems in 2 and 3-d space: ● Demonstrate the concepts of points, lines, and planes ● Describe the result when points, lines, and planes intersect ● Describe relationships between lines and planes in terms of parallel and skew	3 dimensional sketches Spherical geometry	Partitioning space
		2. Distances and midpoints between points on a line or in the coordinate plane Relating absolute value to distance on a number line	Showing the relationship between distance and absolute value visually Finding the midpoint of a segment that lies in the coordinate plane	Showing the relationship between distance and absolute value visually with complicated absolute value equations
		3. Follow written instructions to construct the following: ● A congruent line segment ● Bisect a line segment: locate the midpoint of a line segment ● A line perpendicular to a line through a point on the line. ● A line perpendicular to a line through a point not on the line ● A triangle given three line segments	Apply standard level construction skills to contextualized real life situations (with written instructions provided).	Apply standard level construction skills to contextualized real life situations (without written instructions provided).

5	**Solving and applying linear systems (Systems of linear equations)** − Students use linear functions, linear equations, and systems of linear equations to represent, analyze, and solve a variety of problems. − Students solve systems of two linear equations in two variables and relate the systems to pairs of lines that intersect, are parallel, or are the same line, in the plane. − Students use linear equations, systems of linear equations, linear functions, and their understanding of the slope of a line to analyze situations and solve problems	1. Find solutions to linear systems by using the graph-and-check method. Recognize systems with many or no solutions.	Graphically represent the solutions of a system of inequalities	
		2. Find the solutions to linear systems by using the substitution method		
		3. Find the solutions to linear systems by using the linear combinations method		Linear programming
		4. Use linear systems to solve real life problems using the 4 step problem solving process		Linear programming

6	**Problem solving with exponents, radicals, and the Pythagorean Theorem** **(Exponents, Radicals, and the Pythagorean Theorem)** − Students explain why the Pythagorean theorem is valid by using a variety of methods—for example, by decomposing a square in two different ways. − They apply the Pythagorean theorem to find distances between points in the Cartesian coordinate plane to measure lengths and analyze polygons and polyhedra. − Students encounter some nonlinear functions (such as the inverse proportions that they studied in grade 7 as well as basic quadratic and exponential functions) whose rates of change contrast with the constant rate of change of linear functions. − Students use exponents and scientific notation to describe very large and very small numbers. − They use square roots when they apply the Pythagorean theorem.	1. Understand the difference between linear and exponential growth		
		2. Write really big numbers using scientific notation Successfully use multiplication properties of exponents	Factorials	Combinations
		3. Write really small numbers using scientific notation Evaluate powers that have zero or negative exponents	Deriving exponential functions	Deriving exponential functions
		4. Graph exponential growth and decay functions. Identify the domain and range of exponential functions.		
		5. Apply division properties of exponents		
		6. Understand, write, apply and graph exponential growth functions (and also exponential decay functions)		
		7. Understand square root vocabulary and evaluate square roots		
		8. Solve (quadratic) equations where it's necessary to use square roots	Graph functions involving square roots Rational exponents	Solve radical equations
		9. Understand and apply the simplest form of a radical expression	Factorials Roots other than square roots	
		10. Understand and apply the Pythagorean Theorem		Distance Formula

7	**Understanding polynomials and quadratic relationships** **(Polynomials and Quadratic Equations)** − Students encounter some nonlinear functions (such as the inverse proportions that they studied in grade 7 as well as basic quadratic and exponential functions) whose rates of change contrast with the constant rate of change of linear functions − Construct and compare linear, quadratic, and exponential models and solve problems (Common Core State Standards Initiative, High School: Functions) − Perform arithmetic operations on polynomials (Common Core State Standards Initiative, High School: Algebra) − Solve quadratic equations in one variable (Common Core State Standards Initiative, High School: Algebra) − Understand the relationship between zeros and factors of polynomials (Common Core State Standards Initiative, High School: Algebra)	1. Understand how to add and subtract polynomials.		
		2. Understand how to graph parabolas but using the “3 point method”		
		3. Understand how to classify polynomials according to the number of terms they have and their degree. More completely understand how to graph parabolas by using the “3 point method”		Deriving the equation for a quadratic function given information about its graph Graphing parabolas with graphing software
		4. Understand how to multiply polynomials by using the distributive property (THEN, understand the FOIL memory tool).	Special product patterns	Distance, rate, time applications
		5. Understand, recognize, and USE Special Product Patterns to multiply polynomials.	Special product patterns	Distance, rate, time applications
		6. Use the quadratic formula		
		7. Solve and graph quadratic equations that have already been factored.		Deriving the equation of a quadratic function given information about its graph. Graphing quadratic inequalities.
		8. Factoring and Solving quadratic equations that have a leading coefficient of 1.	Using substitution to solve quadratic equations	Pythagorean Theorem application
		9. Factoring and Solving quadratic equations with a leading coefficient other than 1.	Using substitution to solve quadratic equations Distance, Rate, Time applications	Radical Equations The Quadratic Formula (derive)
		10. Factoring and Solving Quadratic Equations that contain special product patterns	Similar rectangles	Deriving and applying the difference of two cubes pattern Using the graphing application

8	**Problem solving with angle pair relationships** **(Angle pair relationships)** − Students use fundamental facts about distance and angles to describe and analyze figures and situations in two- and three-dimensional space and to solve problems, including those with multiple steps. − They prove that particular configurations of lines give rise to similar triangles because of the congruent angles created when a transversal cuts parallel lines. − Students apply this reasoning about similar triangles to solve a variety of problems, including those that ask them to find heights and distances. − They use facts about the angles that are created when a transversal cuts parallel lines to explain why the sum of the measures of the angles in a triangle is 180 degrees, and they apply this fact about triangles to find unknown measures of angles.	1. Apply the angle addition postulate and solve problems that require an understanding of: ● Linear pairs ● Adjacent angles ● Vertical angles ● Complementary angles ● Supplementary angles		
		2. Apply problem-solving processes to situations involving special angle pairs.		
		3. Solve problems that require an understanding of parallel lines intersected by a transversal. Become comfortable working with all interior and exterior angle pairs, and corresponding angle pairs. Become knowledgeable about the properties relating parallel lines and certain angles.		
		4. Create constructions using a straight edge and compass by reading directions provided.	Apply all previously mentioned constructions in context. Instructions are provided.	Apply all previously mentioned constructions in an unfamiliar context in which the instructions are not provided.
		5. Solve problems involving an understanding of the following triangle properties: ● Sum of a triangle's interior angles is 180 degrees ● An exterior angle is equal in measure to the sum of the two remote interior angles.		Students are also familiar and able to apply the following theorems in proofs: ● If a triangle has two congruent sides, then the triangle has two congruent angles opposite those sides. ● If a pair of alternate interior angles formed by a transversal of two lines is congruent, then the lines are parallel. ● The measure of an exterior angle of a triangle equals the sum of the measures of the two non-adjacent interior angles. ● The sum of the measures of the three angles of a triangle is 180 degrees. ● The measure of the median on the hypotenuse of a right triangle is one-half the measure of the hypotenuse