Mendham Township School District

Mathematics Curriculum - 2012

Grade 8 General & Advanced

In Grade 8, instructional time should focus on three critical 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.

1. Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. 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. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount $m \cdot A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.

Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students 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. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

2. Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

3. 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. Students 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. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

Grade 8 Overview

The Number System

- Know that there are numbers that are not rational, and approximate them by rational numbers.

Expressions and Equations

- Work with radicals and integer exponents.
- Understand the connections between proportional relationships, lines, and linear equations.
- Analyze and solve linear equations and pairs of simultaneous linear equations.

Functions

- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities.

Geometry

- Understand congruence and similarity using physical models, transparencies, or geometry software.
- Understand and apply the Pythagorean Theorem.
- Solve real-world and mathematical problems involving volume of cylinders, cones and spheres.

Statistics and Probability

- Investigate patterns of association in bivariate data.

Mathematical Practices

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

The following chart details the 8th grade curricular focus and is broken out into areas of content, skills, and concepts:

CCCS	CCCS#	Comp & Content	Skills	Concepts
The Number System 8.NS				
Know that there are numbers that are not rational, and approximate them by rational numbers.				
Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.	8NS1	**Definitions:** **1. Rational numbers** **2. Irrational numbers**	**Convert repeating decimals to fractions and fractions to repeating decimals**	***understand that every number has a decimal expansion**
Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., pi2). For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.	8NS2		**Compare irrational numbers by approximating them on a number line and estimate their values**	
Expressions and Equations 8.EE				
Work with radicals and integer exponents				
Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 32 X 3–5 = 3–3 = 1/33 = 1/27.	8EE1	**Exponent properties including:** **1. Negative exponents** **2. Multiplying powers with the same base**	**Simplify expressions using properties of integer exponents**	
Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational	8EE2	**Definitions:** **1. Square root** **2. Cube root** **3. Perfect squares** **4. Perfect cubes** **5. Square root of 2 is irrational**	***Solve equations involving squares and cubes in which square root and cube root is used to solve the equation** ***Calculate square root and cube root**	
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. For example, estimate the population of the United States as 3 X 108 and the population of the world as 7 X 109, and determine that the world population is more than 20 times larger.	8EE3	**Definition:** **1. Scientific notation**	**Use scientific notation to make comparisons through estimation**	
Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.	8EE4	***Choosing units of appropriate size for measurements** ***Interpret scientific notation shown on a calculator**	***Perform operations with numbers expressed in scientific notation** ***Perform operations with numbers in scientific notation and in standard form**	

Understand the connections between proportional relationships, lines, and linear equations.				
Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.	8EE5	**Define slope as rate of change**	***Graph proportional relationships** ***Compare rates/slopes given a graph vs. an equation**	
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 hrough the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.	8EE6	***Slope-intercept form of a linear equation** ***Slope = steepness of a line; rise/run**	***Write an equation of a line in slope-intercept form given a graph** ***Calculate slope**	***Construct meaning for constant slope of a line by using similar triangles (any two points on a line will equal same slope)**
Analyze and solve linear equations and pairs of simultaneous linear equations.				
Solve linear equations in one variable.	8EE7		**Solve linear equations by using inverse operations**	
Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).	8EE7A	**Solutions to a linear equation in one variable:** **1. No solution (a = b where a and b are different numbers)** **2. Infinitely many solutions (a = a)** **3. One solution (x = a)**	***Write equations representative of each type of solution** ***Solve equations in which solutions are none, one, or infinite**	
Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.	8EE7B		**Solve linear equations with rational coefficients requiring simplifying both sides of the equation before using inverse operations (i.e. distributive property and combining like terms)**	
Analyze and solve pairs of simultaneous linear equations.	8EE8	**Defintions:** **1. Systems of Linear Equations** **2. Solutions to systems of linear equations**	**Solve a system of linear equations**	
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.	8EE8A	**Solution to a system of linear equations is the point in which two lines intersect**	**Solve a system of linear equations using graphing**	
Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, 3x + 2y = 5 and 3x +2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.	8EE8B		***Solve a system of equations by substitution** ***Solve a system of equations by elimination** ***Estimate solutions to a system of equations by graphing** ***Solve a system of equations by inspection to see if no solution, one solution, or infinite number of solutions exists**	

Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.	8EE8C		**Write a system of linear equations to model a problem and solve it**	
Functions 8.F				
Define, evaluate, and compare functions.				
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	8F1	**A function can be expressed as a function rule, table, or graph**		**A function assigns each input value to exactly one output value**
Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change	8F2		**Compare rate of change when the function is represented as an equation, table, graph, and/or verbal description**	
Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s2 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.	8F3	**Slope-intercept form is a way to represent a linear function, whose graph is a straight line**	**Provide examples of functions that are linear and non-linear. Identify them as linear or non-linear by looking at their equations and by looking at their graphs.**	
Use functions to model relationships between quantities				
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 initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.	8F4	**Definitions:** **1. Rate of change** **2. Slope** **3. Y-intercept**	**Construct a function using rate of change and its initial value given a description of a relationship, data in a table, or graph**	**Interpret meaning of rate of change and initial value in real world context**
Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	8F5		**Analyze a graph as data increasing, decreasing, linear, or non-linear**	
Geometry 8.G				
Understand congruence and similarity using physical models, transparencies, or geometry software				
Verify experimentally the properties of rotations, reflections, and translations	8G1	**Definitions:** **1. Translation** **2. Reflection** **3. Rotation** **4. Congruency**		**Through inspection, conclude that rotations, reflections, and translations result in figures congruent to the preimage**
Lines are taken to lines, and line segments to line segments of the same length.	8G1A			**A translation, rotation, or reflection of parts of a figure into points, lines, line segments, angles,**

				parallel lines will result in those parts being congruent to their preimages
Angles are taken to angles of the same measure	8G1B			**A translation, rotation, or reflection of parts of a figure into points, lines, line segments, angles, parallel lines will result in those parts being congruent to their preimages**
Parallel lines are taken to parallel lines	8G1C			**A translation, rotation, or reflection of parts of a figure into points, lines, line segments, angles, parallel lines will result in those parts being congruent to their preimages**
Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them	8G2		***Given a sequence of transformations (translation, reflection, rotation), map a preimage to its image.** ***Create a sequence of transformations (translation, reflection, rotation) that can be used to map a preimage to its image**	
Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.	8G3	**Definition:** **1. Dilation**	**Calculate new coordinates of points after a transformation (translation, reflection, rotations, and dilation)**	**Discover the effects on coordinates after a transformation (translation, reflection, rotation, dilation)**
Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two dimensional figures, describe a sequence that exhibits the similarity between them	8G4	**Definition:** **1. Similarity**	***Create similar figures using a series of transformations including dilation and translation, rotation, and reflection** ***Create a sequence of transformations to map similar figures to each other**	
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. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.	8G5	***Angles created by parallel lines cut by a transversal** ***Angle sum and exterior angles of triangles** ***Angle-angle criterion for similar triangles**		**Discover that the sum of three angles of a triangle equal 180 degrees given an argument in terms of transversals**

Understand and apply the Pythagorean Theorem				
Explain a proof of the Pythagorean Theorem and its converse	8G6	**The Pythagorean Theorem and its converse**		**Prove the Pythagorean Theorem and its Converse**
Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	8G7		**Use the Pythagorean Theorem to solve for the unknown lengths in right triangles in 2D and 3D figures and apply to real-world problems**	
Apply the Pythagorean Theorem to find the distance between two points in a coordinate system	8G8	***Distance Formula**	**Use the Pythagorean Theorem to find distance between two points in the coordinate plane (Distance Formula or right triangle)**	
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres				
Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems	8G9	**Formulas of volume:** **1. Cones** **2. Cylinders 3. Spheres**	**Solve real-world problems involving volumes of cones, cylinders, and spheres**	
Statistics and Probability 8SP				
Investigate patterns of association in bivariate data				
Construct and interpret scatter plots for bivariate easurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	8SP1	**Definitions:** **1. Scatterplot** **2. Correlation** **3. Linear/non-linear association**	**Construct and interpret scatterplots given two data sets**	
Know 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	8SP2	**Definitions:** **1. Trend line** **2. Line of Best Fit**	**Draw a line of best fit to show general trend of data and use it to identify how strong or weak the correlation**	
Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, 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.	8SP3		**Write the equation for the line of best fit and interpret the slope and y-intercept in context of the problem**	
Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?	8SP4		**Create a table of data from a scatterplot or experiment, calculate the frequencies, and identify any trends/correlations**	