8th Grade Math Core Essentials

CMP3 Thinking with Mathematical Models

Linear and Nonlinear Relationships: Recognize and model patterns in bivariate data

Goal	Standard
Represent data patterns using graphs, tables, word descriptions, and algebraic expressions	
Investigate the nature of linear functions in contexts	
Use mathematical models to answer questions about linear relationships	
Write linear functions from verbal, numerical, or graphical information	
Analyze and solve linear equations	
Model situations with inequalities expressed as “at most” and “at least” situations	
Investigate the nature of inverse variation in contexts	
Use mathematical models to answer questions about inverse variation relationships	
Compare inverse variation relationships with linear relationships	

Data Analysis: Measure variation in data and strength of association in bivariate data

Goal	Standard
Use data to make predictions	
Fit a line to data that show a linear trend and measure closeness of fit	
Analyze scatter plots of bivariate data to determine the strength of the linear association between the two variables	
Use correlation coefficients informally to describe the strength of the linear association illustrated by scatter plots	
Use standard deviation to measure variability in univariate distributions	
Distinguish between categorical and numerical variables	
Use two-way tables and analysis of cell frequencies and relative frequencies to decide whether two variables are related	

List of Common Core Standards in Thinking with Mathematical Models:

8.EE.B.5 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. *Investigations 2, 3, 4, and 5*

8.EE.C.7 Solve linear equations in one variable. *Investigations 2, and 5*

8.EE.C.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. *Investigation 2*

8.EE.C.8 Analyze and solve pairs of simultaneous linear equations. *Investigation 2*

8.EE.C.8a 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. *Investigation 2*

8.EE.C.8c Solve real-world and mathematical problems leading to two linear equations in two variables. *Investigation 2*

8.F.A.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. *Investigations 1, 2, 3, and 4*

8.F.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or with 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. *Investigation 2*

8.F.A.3 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. *Investigations 1, 2, 3, and 4*

8.F.B.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 initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. *Investigations 1, 2, and 4*

8.F.B.5 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. *Investigations 1, 2, 3, and 4*

8.SP.A.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. *Investigations 1, 2, 3, and 4*

8.SP.A.2 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. *Investigations 1, 2, and 4*

8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *Investigations 1, 2, and 4*

8.SP.A.4 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. *Investigation 5*

CMP3 Looking for Pythagoras

Pythagorean Theorem: Understand and apply the Pythagorean Theorem

Goal	Standard
Develop strategies for finding the distance between two points on a coordinate grid	
Explain a proof of the Pythagorean Theorem	
Use the Pythagorean Theorem and its converse to solve a variety of problems	
Use the Pythagorean Theorem to find the equation of a circle with its center located at the origin	

Real Numbers: Understand that the set of real numbers consists of rational and irrational numbers

Goal	Standard
Interpret square roots and cube roots of numbers by making use of their related geometric representations	
Relate the area of a square to the side length of the square	
Estimate the values of square roots	
Estimate the values of cube roots	
Relate the volume of a cube to the edge length of the cube	
Compare numbers that can be represented as fractions (rational numbers) to numbers that cannot be represented as fractions (irrational numbers) and recognize that the set of real numbers consists of rational and irrational numbers	
Represent rational numbers as fractions and as terminating decimals or repeating decimals	
Recognize that irrational numbers cannot be represented as fractions and are nonterminating, nonrepeating decimals	
Recognize that the square root of a whole number that is not a square is irrational	
Locate irrational numbers on a number line	
Use and understand properties of rational and irrational numbers	

List of Common Core Standards in Looking for Pythagoras:

8.NS.A.1 Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat. Know that other numbers are called irrational. *Investigation 4*

8.NS.A.2 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., $\pi 2$). *Investigations 2 and 4*

8.EE.A.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. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. *Investigations 2 and 4*

8.G.A.4 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. *Investigation 3 and 5*

8.G.B.6 Explain a proof of the Pythagorean Theorem and its converse. *Investigations 1, 2, and 3*

8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. *Investigations 2, 3, 4, and 5*

8.G.B.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. *Investigations 1, 2, 3, and 5*

CMP3 Growing, Growing, Growing

Exponential Functions: Explore problem situations in which two or more variables have an exponential relationship to each other

Goal	Standard
Identify situations that can be modeled with an exponential function	
Identify the pattern of change (growth/decay factor) between two variables that represent an exponential function in a situation, table, graph, or equation	
Represent an exponential function with a table, graph, or equation	
Make connections among the patterns of change in a table, graph, and equation of an exponential function	
Compare the growth/decay rate and growth/decay factor for an exponential function and recognize the role each plays in an exponential situation	

Identify the growth/decay factor and initial value in problem situations, tables, graphs, and equations that represent exponential functions	
Determine whether an exponential function represents a growth (increasing) or decay (decreasing) pattern, from an equation, table, or graph that represents an exponential function	
Determine the values of the independent and dependent variables from a table, graph, or equation of an exponential function	
Use an exponential equation to describe the graph and table of an exponential function	
Predict the *y*-intercept from an equation, graph, or table that represents an exponential function	
Interpret the information that the *y*-intercept of an exponential function represents	
Determine the effects of the growth (decay) factor and initial value for an exponential function on a graph of the function	
Solve problems about exponential growth and decay from a variety of different subject areas, including science and business, using an equation, table, or graph	
Observe that one exponential equation can model different contexts	
Compare exponential and linear functions	

Equivalence: Develop understanding of equivalent exponential expressions

Goal	Standard
Write and interpret exponential expressions that represent the dependent variable in an exponential function	
Develop the rules for operating with rational exponents and explain why they work	
Write, interpret, and operate with numerical expressions in scientific notation	
Write and interpret equivalent expressions using the rules for exponents and operations	
Solve problems that involve exponents, including scientific notation	

List of Common Core Standards in Growing, Growing, Growing:

8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. *Investigation 5*

8.EE.A.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. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. *Investigation 5*

8.EE.A.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. For example, estimate the population of the United States as 3×108 and the population of the world as 7×109, and determine that the world population is more than 20 times larger. *Investigations 1 and 2*

8.EE.A.4 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. *Investigation 5*

8.F.A.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. *Investigations 1, 2, and 5*

8.F.A.2 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. *Investigation 1*

8.F.A.3 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 $A=s^2$ 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. 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. *Investigations 1 and 5*

8.F.B.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 initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. *Investigation 1*

8.F.B.5 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. *Investigations 1 and 2*

CMP3 Butterflies, Pinwheels, and Wallpaper

Transformations: Describe types of transformations that relate points by the motions of reflections, rotations, and translations, and describe methods for identifying and creating symmetric plane figures

Goal	Standard
Recognize properties of reflection, rotation, and translation transformations	
Explore techniques for using rigid motion transformations to create symmetric designs	
Use coordinate rules for basic rigid motion transformations	

Congruence and Similarity: Understand congruence and similarity and explore necessary and sufficient conditions for establishing congruent and similar shapes

Goal	Standard
Recognize that two figures are congruent if one is derived from the other by a sequence of reflection, rotation, and/or translation transformations	
Recognize that two figures are similar if one can be obtained from the other by a sequence of reflections, rotations, translations, and/or dilations	
Use transformations to describe a sequence that exhibits the congruence between figures	
Use transformations to explore minimum measurement conditions for	

establishing congruence of triangles	
Use transformations to explore minimum measurement conditions for establishing similarity of triangles	
Relate properties of angles formed by parallel lines and transversals, and the angle sum in any triangle, to properties of transformations	
Use properties of congruent and similar triangles to solve problems about shapes and measurements	

List of Common Core Standards in Butterflies, Pinwheels, and Wallpaper:

8.EE.B.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*. *Investigation 4*

8.G.A.1 Verify experimentally the properties of rotations, reflections, and translations. *Investigations 1, 2, and 3*

8.G.A.1a Lines are taken to lines, and line segments to line segments of the same length. *Investigations 1 and 2*

8.G.A.1b Angles are taken to angles of the same measure. *Investigations 1, 2, and 3*

8.G.A.1c Parallel lines are taken to parallel lines. *Investigations 1, 2, and 3*

8.G.A.2 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. *Investigations 2 and 3*

8.G.A.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. *Investigations 3 and 4*

8.G.A.4 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. *Investigation 4*

8.G.A.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. *Investigations 3 and 4*

CMP3 Say it with Symbols

Equivalence: Develop understanding of equivalent expressions and equations

Goal	Standard
Model situations with symbolic statements	
Recognize when two or more symbolic statements represent the same context	
Use the properties of real numbers, such as the Distributive Property, to write equivalent expressions	
Determine if different symbolic expressions are mathematically equivalent	
Interpret the information that equivalent expressions represent in a given context	
Determine the equivalent expression or equation that is most helpful in answering a particular question about a relationship	
Use algebraic equations to describe the relationship among the volumes of cylinders, cones and spheres that have the same height and radius	
Solve linear equations involving parentheses	
Determine if a linear equation has a finite number of solutions, an infinite number of solutions, or no solution	
Develop understanding and some fluency with factoring quadratic expressions	
Solve quadratic equations by factoring	
Recognize how and when to use symbols, rather than tables or graphs, to display relationships, generalizations, and proofs	

Functions: Develop an understanding of specific functions such as linear, exponential and quadratic functions

Goal	Standard
Develop proficiency in identifying and representing relationships expressed in problem contexts with appropriate functions and use these relationships to solve the problem	
Analyze equations to determine the patterns of change in the tables and graphs that the equations represent	
Relate parts of a symbolic statement or expression to the underlying properties of the relationship they represent and to the context of the problem	
Determine characteristics of a graph (intercepts, maxima and minima, shape, etc.) of an equation by looking at its symbolic representation	

List of Common Core Standards in Say it with Symbols:

8.EE.A.2 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 $2\sqrt{}$ is irrational. *Investigation 3*

8.EE.C.7 Solve linear equations in one variable. *Investigations 1, 2, 3, and 4*

8.EE.C.7a 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). *Investigation 3*

8.EE.C.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. *Investigations 1, 2, 3, 4, and 5*

8.EE.C.8 Analyze and solve pairs of simultaneous linear equations.*Investigation 3*

8.EE.C.8a 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. *Investigation 3*

8.EE.C.8b Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *Investigation 3*

8.EE.C.8c Solve real-world and mathematical problems leading to two linear equations in two variables. *Investigation 3*

8.F.A.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. *Investigations 2, 3, 4, and 5*

8.F.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *Investigations 2, 4, and 5*

8.F.A.3 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. *Investigations 1, 2, and 4*

8.F.B.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 initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. *Investigations 4 and 5*

8.F.B.5 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. *Investigation 4*

8.G.C.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. *Investigation 2*

CMP3 It's in the System

Linear Equations: Develop understanding of linear equations and systems of linear equations

Goal	Standard
Recognize linear equations in two variables in standard form $Ax+By=C$	
Recognize that a linear equation in the form $Ax+By=C$ has infinitely many solutions (x,y) and the graph of those solutions is always a straight line	
Recognize that the form $Ax+By=C$ of linear equations is equivalent to the form $y=mx+b$ for linear equations	
Continue to develop skills in solving a linear equation in two variables by graphing and with algebraic methods	
Recognize that solving a system of linear equations is equivalent to finding values of the variables that will simultaneously satisfy all equations in the system	
Develop skills in solving systems of linear equations by graphing solutions of separate equations; writing the system of equations in equivalent $y=mx+b$ form; or using combinations of the system to eliminate one variable	
Recognize that systems of linear equations in the form$\{Ax+By=CDx+Ey=F$may have exactly one solution, which is the intersection point of the lines represented by the equations; infinitely many solutions, which is represented by a single line for both equations; or no solution, which is represented by two parallel lines	
Choose between graphing and symbolic methods to efficiently find the solution to a particular system of linear equations	
Gain fluency with symbol manipulation in solving systems of linear equations	
Solve problems that involve systems of linear equations	

Linear Inequalities: Develop understanding of graphing and symbolic methods for solving linear inequalities with one and two variables

Goal	Standard
Recognize differences between strict and inclusive inequalities	
Continue to develop skill in solving a linear inequality in two variables by graphing and symbolic methods	
Develop skill in solving systems of linear inequalities by graphing solutions of each inequality and finding the region of feasible points that satisfy both inequalities; and solving inequalities to find pairs of numbers that satisfy both	

inequalities	
Choose between graphing and symbolic methods to efficiently find the region of feasible points to a particular system of linear inequalities	
Solve a simple system consisting of a linear equation and a quadratic equation in two variables symbolically and graphically	
Solve problems that involve linear inequalities or systems of linear inequalities	

List of Common Core Standards in It's in the System:

8.EE.C.8 Analyze and solve pairs of simultaneous linear equations. *Investigations 1 and 2*

8.EE.C.8a 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. *Investigations 1, 2, and 3*

8.EE.C.8b Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *Investigations 1, 2, and 4*

8.EE.C.8c Solve real-world and mathematical problems leading to two linear equations in two variables. *Investigations 1, 2, 3, and 4*

8.F.A.3 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. *Investigation 1*