Grade 8

Concepts and Procedures

The Number System

RANGE PLD Target A: Know that there are numbers that are not rational and approximate them by rational numbers.	Level 1 students should be able to identify pi as not rational, classify numbers as rational or irrational, and understand that every rational number has a decimal expansion.	Level 2 students should be able to identify approximate locations of irrational numbers between two perfect squares on a number line; identify numbers as rational or irrational; and convert between fractions and terminating decimals.	Level 3 students should be able to use rational approximations of irrational numbers to more accurately locate them on a number line (e.g., the square root of 5 is between 2 and 3 and closer to 2, etc.) and to make numerical comparisons; convert between fractions and repeating decimals; and compare rational numbers to irrational numbers.	Level 4 students should be able to approximate irrational numbers to a specified level of precision (nearest integer or tenth) and should be able to use the approximations to solve problems or estimate the value of an expression.

Expressions and Equations

RANGE PLD Target B: Work with radicals and integer exponents.	Level 1 students should be able to identify and calculate square roots of familiar perfect squares and calculate the square of integers. They should be able to translate between standard form and scientific notation.	Level 2 students should be able to identify and calculate the cube root of familiar perfect cubes and calculate the cube of integers. They should be able to work with and apply the properties of integer exponents of degree 2 or less to produce or identify equivalent numerical expressions.	Level 3 students should be able to identify that the square root of 2 is irrational; calculate or approximate to an appropriate degree of precision the square or cube of a rational number; solve quadratic and cubic equations of the form $x^2 = p$ and $x^3 = p$ where p is a positive rational number; and represent the solution as a square or cube root, respectively. They should be able to work with and perform operations with scientific notation and work with and apply the properties of integer exponents to produce or identify equivalent numerical expressions. They should be able to estimate quantities to express how many times larger or smaller one quantity is than another.	Level 4 students should be able to use scientific notation and choose units of appropriate size for realistic measurements; solve quadratic and cubic equations of the form $x^2 – c = p$ and $x^3 – c = p$ where c is a constant and p is a rational number; and represent the solution as a square or cube root, respectively.

RANGE PLD Target C: Understand the connections between proportional relationships, lines, and linear equations.	Level 1 students should be able to graph a proportional relationship on a coordinate plane.	Level 2 students should be able to compare two different proportional relationships represented in different ways. They should be able to use any right triangle to find the slope of a line.	Level 3 students should be able recognize that slope is a unit rate of change in a proportional relationship and represent proportional relationships as linear equations in slope-intercept form, while also recognizing when and why the *y*-intercept is zero. They should be able to determine the slope of a line and identify the *y*-intercept of a line.	Level 4 students should be able to use similar triangles to explain why the slope is the same between any two distinct points on a nonvertical line in a coordinate plane and to use proportional relationships to interpolate or extrapolate points
RANGE PLD Target D: Analyze and solve linear equations and pairs of simultaneous linear equations.	Level 1 students should be able to solve linear equations in one variable with integer coefficients.	Level 2 students should be able to solve linear equations in one variable with rational coefficients with one solution, infinitely many solutions, or no solution that may require using distributive property and collecting like terms. Students should be able to analyze and solve systems of linear equations graphically, by understanding that the solution of a system of linear equations in two variables corresponds to the point of intersection on a plane.	Level 3 students should be able to produce examples of linear equations in one variable, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. Students should be able to show that a particular linear equation has one solution, no solution, or infinitely many solutions. Students should be able to solve linear systems algebraically and estimate solutions using a variety of approaches.	Level 4 students should be able to analyze and solve problems leading to two linear equations in two variables in multiple representations. Students should be able to classify systems of linear equations as intersecting, collinear, or parallel.

Functions

RANGE PLD Target E: Define, evaluate, and compare functions.	Level 1 students should be able to identify whether a relationship that is represented graphically, in a table, or algebraically is a function. They should be able to compare the properties of two linear functions represented in the same way (graphically or in a table).	Level 2 students should be able to produce input and output pairs for a given function and identify whether an input/output pair satisfies a function. They should be able to compare properties of two functions represented in the same way (algebraic, graphic, tabular, or verbal). They should be able to identify a function as linear or nonlinear based on its graph.	Level 3 students should be able to classify functions as linear or nonlinear in different forms (e.g., graphical, algebraic, verbal description, and/or tabular) and should know linear equations of the form $y = mx + b$ are functions. They should be able to define a function as a rule that assigns exactly one output to each input. They should be able to compare properties of two functions represented in different ways (algebraic, graphic, tabular, or verbal).	Level 4 students should be able to give examples of functions that are not linear and be able to compare properties of two nonlinear functions represented in different ways (algebraic, graphic, tabular, or verbal).
RANGE PLD Target F: Use functions to model relationships between quantities.	Level 1 students should be able to construct a graphical or tabular model to represent a linear relationship between two quantities and should be able to find the rate of change of a linear relationship displayed in a graph or table.	Level 2 students should be able to construct a function to represent a linear relationship between two quantities of a function from a graph, a verbal description of a relationship, or from two sets of x- and y-values given as coordinate pairs or displayed in a table.	Level 3 students should be able to construct a graph to represent verbally described qualitative features and determine the rate of change and initial value (y-intercept) of a function from a graph, a verbal description of a relationship, or from two sets of xy-values given as coordinate pairs or displayed in a table. They should be able to analyze a graph of a linear function to qualitatively describe it.	Level 4 students should be able to 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. They should be able to analyze a graph of a nonlinear function to qualitatively describe it.

Geometry

RANGE PLD Target G: Understand congruence and similarity using physical models, transparencies, or geometry software.	Level 1 students should be able to identify reflections, rotations, and translations and the result of these rigid motions on figures.	Level 2 students should be able to construct reflections and translations of figures in a coordinate plane and identify dilations and the results of dilations on figures.	Level 3 students should be able to understand and describe the effects of a transformation on a figure and its component parts, with or without coordinates. They should be able to use or describe a sequence of transformations to determine or exhibit the congruence or similarity of two figures. They should be able to construct rotations and dilations of figures in a coordinate plane.	Level 4 students should be able to describe a sequence that exhibits the similarity between two shapes and understand that the angle measures are unchanged.
RANGE PLD Target H: Understand and apply the Pythagorean theorem.	Level 1 students should be able to identify the hypotenuse and legs of a right triangle, given the side lengths or an image of a right triangle. They should be able to find the distance between two points on a horizontal or vertical line in a two-dimensional coordinate system.	Level 2 students should be able to apply the Pythagorean theorem to determine whether a triangle is a right triangle, given its side lengths.	Level 3 students should be able to apply the Pythagorean theorem to determine the unknown side lengths of right triangles and to find the distance between two points in a coordinate system in two dimensions.	Level 4 students should be able to apply the Pythagorean theorem to find the distance between two points in three dimensions.
RANGE PLD Target I: Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	Level 1 students should be able to identify the key dimensions (i.e., radii, heights, circumferences, and diameters) of cones, cylinders, and spheres.	Level 2 students should be able to recognize the appropriate formula for the volumes of a cone, a cylinder, and a sphere and should be able to connect the key dimensions to the appropriate locations in the formula.	Level 3 students should be able to apply the appropriate formula to calculate the volumes of a cone, a cylinder, and a sphere and use them to solve real-world and mathematical problems.	Level 4 students should be able to solve unfamiliar or multistep problems involving volumes of cones, cylinders, and spheres.

Statistics and Probability

RANGE ALD Target J: Investigate patterns of association in bivariate data.	Level 1 students should be able to investigate a scatter plot for clustering between two quantities and construct a scatter plot from given data. Students should also be able to construct a two–way frequency table from given categorical data.	Level 2 students should be able to investigate a scatter plot for positive, negative, and linear association and informally fit a line to data for a given scatter plot that suggests a linear association. They should be able to calculate frequencies from categorical data in a two-way frequency table.	Level 3 students should be able to construct and interpret scatter plots to describe patterns such as clustering, outliers, positive or negative association, and linear and nonlinear association. Students should be able to informally fit a straight line to a given scatter plot and use the line to interpret the slope and *y*-intercept. They should be able to interpret and use relative frequencies from a two-way table to describe possible association between two variables.	Level 4 students should be able to informally fit a straight line to a given scatter plot, write an equation for the line, and use trend lines and associations between variables in two-way frequency tables to make predictions in real-world situations.