In eighth grade, students will acquire skills and abilities in 8 Mathematical Practices and 5 Mathematical Domains:

Mathematical Practices

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

Note: The standards marked with ** are Algebra standards, and the depth to which they will be covered in this class will vary.

Mathematical Domains

- **The Number System**
    - know that numbers that are not rational are called irrational; understand informally that every number has a decimal expansion
    - ** Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
    - for rational numbers show that the decimal expansion repeats eventually; convert a decimal expansion which repeats eventually into a rational number.
    - 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.
    - ** Rewrite expressions involving radicals and rational exponents using the properties of exponents
    - ** Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents

- **Expressions and Equations**
    - know and apply the properties of integer exponents to generate equivalent numerical expressions.
    - ** Use the structure of an expression to identify ways to rewrite it.
    - 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 2 is irrational.
    - use numbers expressed as a single digit multiplied by an integer power of 10 to estimate very large or very small quantities

- use numbers expressed in the form of a single digit multiplied by an integer power of 10 to express how many times more one is than the other.
- 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.
- graph proportional relationships interpreting the unit rate as the slope of the graph; compare two different proportional relationships represented in different ways.
- use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in a coordinate plane.
- ** Interpret expressions that represent a quantity in terms of its context. - Interpret parts of an expression, such as terms, factors, and coefficients
- solve linear equations in one variable.
- analyze and solve pairs of simultaneous linear equations understanding that the solution corresponds to the point of intersection
- ** Solve quadratic equations in one variable - Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. **Recognize when the solutions of a quadratic equation result in non-real solutions and** write them as a ± bi for real numbers a and b.
- ** Solve quadratic equations in one variable - Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
- ** Graph the solutions of a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set of a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

- **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.
  - ** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
  - ** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
  - compare properties of two functions, each represented differently (algebraically, graphically, numerically in tables, or by verbal descriptions).
  - 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.
  - 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 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.

- describe qualitatively the functional relationship between two quantities by analyzing a graph; sketch a graph that exhibits the qualitative features of a function described verbally.
- ** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.
- ** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function - Use the process of factoring and completing the square in a quadratic function to show zeros, maximum/minimum values, and symmetry of the graph, and interpret these in terms of a context
- ** Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- ** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases - Graph linear and quadratic functions and show intercepts, maxima, and minima.
- ** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (including reading these from a table)
- ** Interpret expressions that represent a quantity in terms of its context. - Interpret parts of an expression, such as terms, factors, and coefficients
- ** Interpret expressions that represent a quantity in terms of its context. -Interpret complicated expressions by viewing one or more of their parts as a single entity.
- ** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- ** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- ** Write arithmetic and geometric sequences both recursively and with an explicit formula to model situations and translate between the two forms
- ** Graph exponential functions showing intercepts and end behavior.
- ** Distinguish between situations that can be modeled with linear and exponential functions. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

- **Geometry**
  - verify experimentally the properties of rotations, reflections, and translations:
    - - lines are taken to lines, and line segments to line segments of the same length
    - - angles are taken to angles of the same measure
    - - parallel lines are taken to parallel lines
  - 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.

- describe the effects of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
- 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.
- use informal arguments to establish facts about the angle sum and exterior angle of a triangle and other angles created when parallel lines are cut by a transversal, and the angle-angle criterion for the similarity of triangles.
- understand the relationship among the sides of a right triangle.
- apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
- apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
- know the formulas for the volumes of cones, cylinders, and spheres, and use them to solve real-world and mathematical problems.

- **Statistics and Probability**
  - ** Represent data with plots on the real number line (dot plots, histograms, and box plots)
  - 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.
  - 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.
  - use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
  - ** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
  - ** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets
  - understand that patterns of association can also be seen in bivariate categorical data. Construct and interpret a two-way table summarizing the data. Use relative frequencies calculated to describe possible associations between the two variables.