ALGEBRA 2
USING THE COMMON CORE

The following three standards should be imbedded throughout this course:

*N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

*N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.

*N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

1. Functions

F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F.BF.4a Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) = 2x^3 or f(x) = (x+1)/(x-1) for x ≠ 1.

F.BF.1b Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

2. Advanced Trigonometry

F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
3. Algebraic Fractions

A.APR.6 **Rewrite simple rational expressions in different forms:** write \( \frac{a(x)}{b(x)} \) in the form \( q(x) + r(x)/b(x) \), where \( a(x), b(x), q(x), \) and \( r(x) \) are polynomials with the degree of \( r(x) \) less than the degree of \( b(x) \), using inspection, long division, or, for the more complicated examples, a computer algebra system.

A.APR.2 Know and apply the **Remainder Theorem:** For a polynomial \( p(x) \) and a number \( a \), the remainder on division by \( x - a \) is \( p(a) \), so \( p(a) = 0 \) if and only if \( (x - a) \) is a factor of \( p(x) \).

4. Solving Equations & Inequalities

*A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations \( y = f(x) \) and \( y = g(x) \) intersect are the **solutions of the equation** \( f(x) = g(x) \); find the solutions approximately, e.g., using technology to graph the functions, make **tables of values**, or find successive approximations. Include cases where \( f(x) \) and/or \( g(x) \) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

A.CED.1 **Create equations and inequalities in one variable** and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

5. Complex Numbers

N.CN.1 Know there is a **complex number** \( i \) such that \( i^2 = -1 \), and every complex number has the form \( a + bi \) with \( a \) and \( b \) real.

N.CN.2 Use the relation \( i^2 = -1 \) and the **commutative, associative, and distributive** properties to **add, subtract, and multiply** complex numbers.

A.REI.4b **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 **quadratic formula gives complex solutions** and write them as \( a \pm bi \) for real numbers \( a \) and \( b \).

6. Quadratic Equations

A.SSE.3b **Complete the square** in a quadratic expression to reveal the maximum or minimum value of the function it defines.
G.GPE.1  Derive the **equation of a circle** of given center and radius using the Pythagorean Theorem; **complete the square** to find the center and radius of a circle given by an equation.

A.REI.4a  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.

A.REI.7  **Solve a simple system** consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line \(y = -3x\) and the circle \(x^2 + y^2 = 3\).*

A.REI.10  **Understand** that the **graph** of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

F.IF.7a  **Graph linear and quadratic functions** and show intercepts, maxima, and minima.

F.IF.8a  Use the process of **factoring** and **completing the square** in a quadratic function to show zeros, extreme values, and symmetry of the graph, and **interpret** these in terms of a context.

N.CN.7  **Solve quadratic equations** with real coefficients that have complex solutions.

A.CED.1  **Create equations and inequalities** in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

7. Exponents and Exponential Functions

N.RN.1  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. *For example, we define \(5^{1/3}\) to be the cube root of 5 because we want \((5^{1/3})^3 = 5^{(1/3)\cdot3}\) to hold, so \((5^{1/3})^3\) must equal 5.*

*F.IF.4  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; end behavior; and periodicity.

*F.IF.5  Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function \(h(n)\) gives the number of person-hours it takes to assemble \(n\) engines in a factory, then the positive integers would be an appropriate domain for the function.*
F.IF.7e  **Graph exponential and logarithmic** functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

A.SSE.3c  Use the **properties of exponents** to transform expressions for exponential functions. For example, the expression $1.15^t$ can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

F.LE.1a  **Prove** that **linear functions grow by equal differences** over equal intervals, and that **exponential functions grow by equal factors** over equal intervals.

F.BF.3  **Identify** the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of $k$ (both positive and negative); find the value of $k$ given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

F.LE.3  Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.5  Interpret the parameters in a linear or exponential function in terms of a context.

### 8. Logarithms

F.BF.5  (+) Understand the inverse relationship between **exponents and logarithms** and use this relationship to solve problems involving logarithms and exponents.

F.LE.4  For **exponential models**, express as a logarithm the solution to $ab^{ct} = d$ where $a$, $c$, and $d$ are numbers and the base $b$ is 2, 10, or $e$; **evaluate the logarithm** using technology.

F.IF.7e  **Graph exponential and logarithmic** functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

A.SSE.3c  Use the **properties of exponents** to **transform expressions** for exponential functions. For example, the expression $1.15^t$ can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

F.IF.8b  Use the **properties of exponents** to **interpret expressions** for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{10t}$, and classify them as representing exponential growth or decay.

F.LE.1c  Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
9. Sequences and Series

F.BF.1a Determine an explicit expression, a **recursive** process, or steps for calculation from a context.

F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose **domain** is a subset of the integers. For example, the Fibonacci sequence is defined recursively by \( f(0) = f(1) = 1, f(n + 1) = f(n) + f(n - 1) \) for \( n \geq 1 \).

*F.BF.2 Write **arithmetic** and **geometric sequences** both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

A.SSE.4 **Derive the formula** for the sum of a **finite geometric series** (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.

F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

10. Trigonometric Graphs and Identities

*F.IF.4 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; end behavior; and periodicity.

F.TF.5 Choose trigonometric functions to **model periodic phenomena** with specified amplitude, frequency, and midline.

F.IF.7e **Graph exponential and logarithmic functions**, showing intercepts and end behavior, and **trigonometric functions**, showing **period**, **midline**, and **amplitude**.

A.APR.4 **Prove polynomial identities** and use them to describe numerical relationships. For example, the polynomial identity \((x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2\) can be used to generate **Pythagorean triples**.

F.TF.8 **Prove the Pythagorean identity** \( \sin^2(\theta) + \cos^2(\theta) = 1 \) and use it to **calculate trigonometric ratios**.

*G.SRT.7 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
11. Representing Data

S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.2 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.

S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

12. Normal Distribution

S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

13. Representing Bivariate Data

S.ID.6a Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

S.ID.6b Informally assess the fit of a function by plotting and analyzing residuals.

S.ID.6c Fit a linear function for a scatter plot that suggests a linear association.

S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.

S.ID.9 Distinguish between correlation and causation.
14. Gathering Data

S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.2 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.

S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

15. Probability

S.CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).

S.CP.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

S.CP.3 Understand the conditional probability of A given B as \( \frac{P(A \text{ and } B)}{P(B)} \), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.

S.CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.

S.CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.

S.CP.6 Find the conditional probability of A given B as the fraction of B’s outcomes that also belong to A, and interpret the answer in terms of the model.

S.CP.7 Apply the Addition Rule, \( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \), and interpret the answer in terms of the model.
16. Making Inferences

S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.

S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

S.IC.6 Evaluate reports based on data.