Cherokee County School District

Teaching & Learning Standards



ENHANCED ALGEBRA

Mathematics

Year Long Mathematical Practices (MP):

Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration, and expression. Seek help and apply feedback. Set and monitor goals.

MP.1 – Make sense of problems and persevere in solving them.

MP.2 – Reason abstractly and quantitatively

MP.3 – Construct viable arguments and critique reasoning of others.

MP.4 – Model with mathematics.

MP.5 – Use appropriate tools strategically.

MP.6 – Attend to precision.

MP.7 – Look for and make use of structure.

MP.8 – Look for and express regularity in repeated reasoning.

Unit 1: Modeling Linear Relationships & Functions (5-6 weeks)

In this unit, students will incorporate patterning and algebraic reasoning to create, interpret, solve, and graph linear equations and linear functions in different forms, depending upon the given context. Students will interpret expressions with multiple factors and/or terms and manipulate linear and literal equations expressed in various forms. Students will use formal notation to represent linear functions, use functional and graphical reasoning to informally compare linear and non-linear functions using parent graphs, and identify key characteristics of graphs of linear functions. Students will also construct and interpret arithmetic sequences as functions, algebraically and graphically, to model and explain real-life phenomena.

Overarching Standards for Unit 1

PAR.3: Create and interpret expressions within relevant situations. Create, interpret, and solve linear equations and linear inequalities in one variable to model and explain real phenomena.

PAR.4: Show and explain the connections between proportional and non-proportional relationships, lines, and linear equations; create and interpret graphical, mathematical models and use the graphical, mathematical model to explain real-life phenomena represented in the graph.

FGR.5: Describe the properties of functions to define, evaluate, and compare relationships, and use functions and graphs of functions to model and explain real-life phenomena.

FGR.2: Construct and interpret arithmetic sequences as functions, algebraically and graphically, to model and explain real-life phenomena. Use formal notation to represent linear functions and the key characteristics of graphs of linear functions, and informally compare linear and non-linear functions using parent graphs.

Standards for Student Mastery for Unit 1

PAR.3.1: Interpret expressions and parts of an expression, in context, by utilizing formulas or expressions with multiple terms and/or factors.

PAR.3.2: Describe and solve linear equations in one variable with one solution (x = a), infinitely many solutions (a = a), or no solutions (a = b). 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).

PAR.3.3: Create and solve linear equations and inequalities in one variable within a relevant, real-life application.

PAR.3.4: Using algebraic properties and the properties of real numbers, justify the steps of a one-solution equation or inequality.

PAR.3.5: Solve linear equations and inequalities in one variable with coefficients represented by letters and explain the solution based on the contextual, mathematical situation.

PAR.3.6: Use algebraic reasoning to fluently manipulate linear and literal equations expressed in various forms to solve relevant, mathematical problems.

PAR.4.1: Use the equation y = mx (proportional) for a line through the origin to derive the equation y = mx + b (non-proportional) for a line intersecting the vertical axis at b.

PAR.4.2: Show and explain that the graph of an equation representing an applicable situation in two variables is the set of all its solutions plotted in the coordinate plane.

FGR.5.1: Show and explain that a function is a rule that assigns to each input exactly one output.

FGR.5.2: Within realistic situations, identify and describe examples of functions that are linear or nonlinear. Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

FGR.5.3: Relate the domain of a linear function to its graph and where applicable to the quantitative relationship it describes.

FGR.5.4: Compare properties (rate of change and initial value) of two functions used to model an authentic situation each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

FGR.5.5: Write and explain the equations y = mx + b (slope-intercept form), Ax + By = C (standard form), and $(y - y_1) = m(x - x_1)$ (point-slope form) as defining a linear function whose graph is a straight line to reveal and explain different properties of the function.

FGR.5.6: Write a linear function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

FGR.5.7: 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.

FGR.5.8: Explain the meaning of 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.

FGR.5.9: Graph and analyze linear functions expressed in various algebraic forms and show key characteristics of the graph to describe applicable situations.

FGR.2.1: Use mathematically applicable situations algebraically and graphically to build and interpret arithmetic sequences as functions whose domain is a subset of the integers.

FGR.2.2: Construct and interpret the graph of a linear function that models real-life phenomena and represent key characteristics of a graph using formal notation.

FGR.2.5: Analyze the difference between linear functions and nonlinear functions by informally analyzing the graphs of various parent functions (linear, quadratic, exponential, absolute value, square root, and cube root parent curves).

FGR.2.3: Relate the domain and range of a linear function to its graph and, where applicable, to the quantitative relationship it describes. Use formal interval and set notation to describe the domain and range of linear functions.

FGR.2.4: Use function notation to build and evaluate linear functions for inputs in their domains and interpret statements that use function notation in terms of a mathematical framework.

Unit 2: Analyzing Systems of Linear Equations and Inequalities (3-4 weeks)

In Unit 2, students will extend their understanding of solving equations and functional and graphical reasoning to solving systems of equations, including those created by parallel and/or perpendicular lines. Solving systems should include estimating solutions graphically, solving using substitution, and solving using elimination. Students will also create, analyze, interpret, solve, and graph linear inequalities in one and two variables and find solutions to systems of linear inequalities to model real-life phenomena.

Overarching Standards for Unit 2

FGR.7: Justify and use various strategies to solve systems of linear equations to model and explain real-life phenomena.
PAR.4: Create, analyze, and solve line inequalities in two variable and systems of linear inequalities to model real-life phenomena.

Standards for Student Mastery for Unit 2

FGR.7.1 Interpret and solve relevant mathematical problems leading to two linear equations in two variables.
FGR.7.2 Show and explain that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because the points of intersection satisfy both equations simultaneously.
FGR.7.3 Approximate solutions of two linear equations in two variables by graphing the equations and solving simple cases by inspection.
FGR.7.4 Analyze and solve systems of two linear equations in two variables algebraically to find exact solutions.

FGR.7.5 Create and compare the equations of two lines that are either parallel to each other, perpendicular to each other, or neither parallel nor perpendicular.

PAR.4.1: Create and solve linear inequalities in two variables to represent relationships between quantities including mathematically applicable situations; graph inequalities on coordinate axes with labels and scales.
PAR.4.2: Represent constraints of linear inequalities and interpret data points as possible or not possible.
PAR.4.3: Solve systems of linear inequalities by graphing, including systems representing a mathematically applicable situation.

Unit 3: Investigating Rational & Irrational Numbers (2-3 weeks)

In this unit, students extend their knowledge of numerical reasoning and real numbers to include irrational numbers, develop an understanding of the properties of exponents, and perform operations with numbers expressed in scientific notation.

Overarching Standards for Unit 3

NR.1: Solve Problems involving irrational numbers and rational approximations of irrational numbers to explain real-life applications.
NR.2: Solve problems involving radicals and integer exponents including relevant application situations; apply place value understanding with scientific notation and use scientific notation to explain real-life phenomena.
NR.5: Investigate rational and irrational numbers and rewrite expressions involving square roots and cube roots.

Standards for Student Mastery for Unit 3

NR.1.1: Distinguish between rational and irrational numbers using decimal expansion. Convert a decimal expansion which repeats eventually into a rational number.
NR.1.2: Approximate irrational numbers to compare the size of irrational numbers, locate them approximately on a number line, and estimate the value of expressions.

NR.2.1: Apply the properties of integer exponents to generate equivalent numerical expressions.
NR.2.2: Use square root and cube root symbols to represent solutions to equations. Recognize that x^2 = p (where p is a positive rational number and |x| ≤ 25) has two solutions and x3 = p (where p is a negative or positive rational number and |x| ≤ 10) has one solution. Evaluate square roots of perfect squares ≤ 625 and cube roots of perfect cubes ≥ -1000 and ≤ 1000.
NR.2.3: Use numbers expressed in scientific notation to estimate very large or very small quantities, and to express how many times as much one is than the other.
NR.2.4: Add, subtract, multiply and divide numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Interpret scientific notation that has been generated by technology (e.g., calculators or online technology tools).

NR.5.1: Rewrite algebraic and numeric expressions involving radicals, limited to square roots and cube roots.

NR.5.2 Using numerical reasoning, show and explain that the sum or product of rational numbers is rational, the sum of a rational number and an irrational number is irrational, and the product of a nonzero rational number and an irrational number is irrational.

Unit 4: Modeling and Analyzing Quadratic Functions (5-6 weeks)

In Unit 4, students will analyze quadratic functions. Students will (1) investigate key features of graphs; (2) solve quadratic equations by taking square roots, factoring ($x^2 + bx + c$ AND $ax^2 + bx + c$), completing the square, and using the quadratic formula; (3) compare and contrast graphs in standard, vertex, and intercept forms. Students will only work with real number solutions.

Overarching Standards for Unit 4

PAR.6: Build quadratic expressions and equations to represent and model real-life phenomena; solve quadratic equations in contextual situations.

FGR.7: Construct and interpret quadratic functions from data points to model and explain real-life phenomena; describe key characteristics of the graph of a quadratic function to explain a contextual situation for which the graph serves as a model.

Standards for Student Mastery for Unit4

PAR.6.1: Interpret quadratic expressions and parts of a quadratic expression that represent a quantity in terms of its context.

PAR.6.2: ~~Fluently~~ Choose and produce an equivalent form of a quadratic expression <u>fluently</u> to reveal and explain properties of the quantity represented by the expression.

PAR.6.3: Create and solve quadratic equations in one variable and explain the solution in the framework of applicable phenomena.

PAR.6.4: Represent constraints by quadratic equations and interpret data points as possible or not possible in a modeling framework.

FGR.7.1: Use function notation to build and evaluate quadratic functions for inputs in their domains and interpret statements that use function notation in terms of a given framework.

FGR.7.2: Identify the effect on the graph generated by a quadratic function when replacing f(x) with f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs.

FGR.7.3: Graph and analyze the key characteristics of quadratic functions including contextual situations.

FGR.7.4: Relate the domain and range of a quadratic function to its graph and, where applicable, to the quantitative relationship it describes.

FGR.7.5: Rewrite a quadratic function representing a mathematically applicable situation to reveal the maximum or minimum value of the function it defines. Explain what the value describes in context.

FGR.7.6: Create quadratic functions in two variables to represent relationships between quantities; graph quadratic functions on the coordinate axes with labels and scales.

FGR.7.7: Estimate, calculate, and interpret the average rate of change of a quadratic function and make comparisons to the average rate of change of linear functions.

FGR.7.8: Write a function defined by a quadratic expression in different but equivalent forms to reveal and explain different properties of the function.

FGR.7.9: Compare characteristics of two functions each represented in a different way.

Semester 2 (January – May)

Unit 5: Modeling and Analyzing Exponential Expressions and Equations, and Functions (5-6 weeks)

In Unit 5, students will interpret exponential expressions, one variable exponential equations in context, and understand parameters of two variable exponential equations. Students will also construct and analyze the graph of an exponential function to explain a contextual situation for which the graph serves as a model; compare exponential with linear and quadratic functions.

Overarching Standards for Unit 5

PAR.8: Create and analyze exponential expressions and equations to represent and model real-life phenomena; solve exponential equations in mathematically applicable situations.

FGR.9: Construct and analyze the graph of an exponential function to explain a mathematically applicable situation for which the graph serves as a model; compare exponential with linear and quadratic functions.

Standards for Student Mastery for Unit 5

PAR.8.1: Interpret exponential expressions and parts of an exponential expression that represent a quantity in terms of its framework.

PAR.8.2: Create exponential equations in one variable, limited to those containing like bases or that could easily be transferred to like bases with linear operations, and use them to solve problems, including mathematically applicable situations. $(3^{x+2} = 3^{2x+4})$

PAR.8.3: Create exponential equations in two variables to represent relationships between quantities, including in mathematically applicable situations; graph equations on coordinate axes with labels and scales.

PAR.8.4: Represent constraints by exponential equations and interpret data points as possible or not possible in a modeling environment.

FGR.9.1: Use function notation to build and evaluate exponential functions for inputs in their domains and interpret statements that use function notation in terms of a context

FGR.9.2: Graph and analyze the key characteristics of simple exponential functions based on mathematically applicable situations.

FGR.9.3: Identify the effect on the graph generated by an exponential function when replacing f(x) with f(x) + k, and k f(x), for specific values of k (both positive and negative); find the value of k given the graphs

FGR.9.4: Use mathematically applicable situations algebraically and graphically to build and interpret geometric sequences as functions whose domain is a subset of the integers.

FGR.9.5: Compare characteristics of two functions each represented in a different way.

Unit 6: Investigating Data and Statistical Reasoning (3-4 weeks)

In Unit 6, students will extend the study of linear relationships by exploring models and tables to model relationships between quantities and describe the rate of change. Students will collect, analyze, and interpret univariate quantitative data to answer statistical investigative questions that compare groups to solve real-life problems. Students will represent bivariate data on a scatter plot and fit a function to the data to make predictions, answer statistical investigative questions, solve real-life problems based on data distributions.

Overarching Standards for Unit 6

FGR.6: Solve practical, linear problems involving situations using bivariate quantitative data.
DSR.10: Collect, analyze, and interpret univariate quantitative data to answer statistical investigative questions that compare groups to solve real-life problems; Represent bivariate data on a scatter plot and fit a function to the data to answer statistical questions and solve real-life problems.

Standards for Student Mastery for Unit 6

DSR.10.1: Use statistics appropriate to the shape of the data distribution to compare center (median and mean) and variability (interquartile range, standard deviation) of two or more distributions by hand and using technology.
DSR.10.2: Interpret differences in shape, center, and variability of the distributions in the framework (context), accounting for possible effects of extreme data points (outliers).

FGR.6.1: Show that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, visually fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line of best fit.
DSR.10.3: Represent data on two quantitative variables on a scatter plot and describe how the variables are related.

FGR.6.2: Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercepts
FGR.6.3: Explain the meaning of the predicted slope (rate of change) and the predicted intercept (constant term) of a linear model in the context of the data.
DSR.10.4: Interpret the slope (predicted rate of change) and the intercept (constant term) of a linear model in the framework of the data.

FGR.6.4: Use appropriate graphical displays from data distributions involving lines of best fit to draw informal inferences and answer the statistical investigative question posed in an unbiased statistical study.

DSR.10.5: Calculate the line of best fit and interpret the correlation coefficient, r, of a linear fit using technology. Use r to describe the strength of the goodness of fit of the regression. Use the linear function to make predictions and assess how reasonable the prediction is in context.

DSR.10.6: Decide which type of function is most appropriate by observing graphed data.

DSR.10.7: Distinguish between correlation and causation.

Unit 7: Algebraic Connections to Geometric Concepts (3-4 weeks)

In Unit 7, students will extend their work with irrational numbers and apply their geometric and spatial reasoning to interpret and solve problems involving the Pythagorean Theorem. Students will work with right triangles and investigate proofs of the Pythagorean Theorem and its converse. Students will solve problems involving distance, midpoint, slope, area, and perimeter to model and explain real-life phenomena. They will also extend their knowledge of volume from previous grades to solve problems involving cones, cylinders, and spheres

Overarching Standards for Unit 7

GSR.8: Solve geometric problems involving the Pythagorean Theorem and the volume of geometric figures to explain real-life phenomena
GSR.3: Solve problems involving distance, midpoint, slope, area, and perimeter to model and explain real-life phenomena.

Standards for Student Mastery for Unit 7

GSR.8.1: Explain a proof of the Pythagorean Theorem and its converse using visual models.
GSR.8.2: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles within authentic mathematical problems in two and three dimensions.
GSR.8.3: Apply the Pythagorean Theorem to find the distance between two points in a coordinate system in practical mathematical problems.

GSR.3.1: Solve real-life problems involving slope, parallel lines, perpendicular lines, area, and perimeter

GSR.3.2: Apply the distance formula, midpoint formula, and slope of line segments to solve real-world problems.

GSR.8.4: Apply the formulas for the volume of cones, cylinders, and spheres and use them to solve relevant, real-life problems.

Unit 8: Culminating Capstone Unit (1-2 weeks)

The capstone unit applies content that has already been learned in previous interdisciplinary PBLs and units throughout the school year. The capstone unit is an interdisciplinary unit that allows students to create a presentation, report, or demonstration that could include their models used to answer an overarching driving question. (e.g., Students can present their solution(s), findings, project, or answer to the driving question to a larger audience during the culminating capstone unit.)

Standards for Student Mastery for Unit 8

PAR.3: Create and interpret expressions within relevant situations. Create, interpret, and solve linear equations and linear inequalities in one variable to model and explain real phenomena.

PAR.4: Show and explain the connections between proportional and non-proportional relationships, lines, and linear equations; create and interpret graphical, mathematical models and use the graphical, mathematical model to explain real-life phenomena represented in the graph.

PAR.6: Build quadratic expressions and equations to represent and model real-life phenomena; solve quadratic equations in contextual situations.

PAR.8: Create and analyze exponential expressions and equations to represent and model real-life phenomena; solve exponential equations in mathematically applicable situations.

FGR.2: Construct and interpret arithmetic sequences as functions, algebraically and graphically, to model and explain real-life phenomena. Use formal notation to represent linear functions and the key characteristics of graphs of linear functions, and informally compare linear and non-linear functions using parent graphs.

FGR.5: Describe the properties of functions to define, evaluate, and compare relationships, and use functions and graphs of functions to model and explain real-life phenomena.

FGR.6: Solve practical, linear problems involving situations using bivariate quantitative data.

FGR.7: Justify and use various strategies to solve systems of linear equations to model and explain real-life phenomena.

FGR.9: Construct and analyze the graph of an exponential function to explain a mathematically applicable situation for which the graph serves as a model; compare exponential with linear and quadratic functions.

NR.1: Solve Problems involving irrational numbers and rational approximations of irrational numbers to explain real-life applications.

NR.2: Solve problems involving radicals and integer exponents including relevant application situations; apply place value understanding with scientific notation and use scientific notation to explain real-life phenomena.

NR.5: Investigate rational and irrational numbers and rewrite expressions involving square roots and cube roots.

DSR.10: Collect, analyze, and interpret univariate quantitative data to answer statistical investigative questions that compare groups to solve real-life problems; Represent bivariate data on a scatter plot and fit a function to the data to answer statistical questions and solve real-life problems.

GSR.8: Solve geometric problems involving the Pythagorean Theorem and the volume of geometric figures to explain real-life phenomena

GSR.3: Solve problems involving distance, midpoint, slope, area, and perimeter to model and explain real-life phenomena.