DESK DAVIS ESSENTIAL SKILLS AND KNOWLEDGE

Secondary Math I

Essential Skills and Knowledge
Refer to the Utah State Mathematics Standards for more detail

Mathematical Practice Standards

Students will be able to:

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

Number and Quantity

Students will be able to:

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, and choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Algebra – Seeing Structure in Expressions

Students will be able to:

1. Interpret linear expressions and exponential expressions with integer components that represent a quantity in terms of its context—including terms, factors, and coefficients.

Algebra – Creating Equations

Students will be able to:

1. Create equations and inequalities in one variable and use them to solve problems, including equations arising from linear and simple exponential functions.
2. Create equations in two or more variables to represent relationships between quantities and graph equations on coordinate axes with labels and appropriate scale.
3. Represent constraints by equations or inequalities and by systems of equations or inequalities and interpret solutions as viable or non-viable options in a modeling context.
4. Rearrange formulas to highlight a quantity of interest using the same reasoning as in solving equations.

Algebra – Reasoning with Equations and Inequalities

Students will be able to:

1. Understand that a function from one set (domain) to another set (range) assigns to each element of the domain exactly one element of the range. In other words, students will be able to understand that 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, including that the graph of f is the graph of the equation $y = f(x)$.
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers with emphasis placed on arithmetic and geometric sequences as examples of linear and exponential functions.
4. Interpret key features of graphs and tables in terms of quantities, and sketch graphs showing key features given a verbal description of the relationship for functions that model a relationship between two quantities. *Key features include intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.*
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.*
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval including estimating the rate of change from a graph.
7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. *Linear functions should display intercepts and exponential functions should display intercepts and end behavior.*
8. Compare properties of two functions each represented in a different way including algebraically, graphically, numerically in tables, or by verbal descriptions.

Functions – Building Linear or Exponential Functions

Students will be able to:

1. Write a function that describes a relationship between two quantities using explicit expressions, recursive processes, or steps for calculation from a context and be able to relate the functions to a model.
2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. Limit to linear and exponential functions and connect arithmetic sequences to linear functions and geometric sequences to exponential functions.
3. Identify the effect on the parent graph by replacing $f(x)$ with $f(x) + k$, for specific falues of k including positive and negative values for k and find the value of k given the graph. Relate

the vertical translation of a linear function to its y-intercept. Experiment with cases and illustrate using technology. Limit to linear and exponential equations and inequalities. Limit exponential equations that require evaluation of exponential functions at integer inputs.

Functions – Linear and Exponential

Students will be able to:

1. Distinguish between situations that can be modeled with linear and exponential functions including proving that linear functions grow by equal differences over equal intervals and exponential functions grow by equal factors over equal intervals. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another and in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
2. Construct linear and exponential functions, including arithmetic and geometric sequences given a graph, a description of a relationship, or two input-output pairs (including information contained in a table of values).
3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly.
4. Interpret the parameters in a linear or exponential function in terms of a context. Limit exponential functions to those of the form $f(x) = b^x + k$.

Geometry – Congruence

Students will be able to:

1. Know precise definitions of angle, circle, perpendicular line, parallel like, and line segment based on the undefined notions of point, line distance along a line, and distance around a circular arc.
2. Represent transformations in the plane using transparencies and geometry software. Describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (translation verses horizontal stretch).
3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel likes, and line segments.
5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using graph paper, tracing paper, or using technology. Specify a sequence of transformations that will carry a given figure onto another. Point out the basis of rigid motions in geometric concepts—translations move points a specified distance along a line parallel to a specified line and rotations move objects along a circular arc with a specific center through a specific angle.
6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion to decide whether they are congruent.

7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
9. Make formal geometric constructions with a variety of tools and methods such as compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc. with an emphasis on the ability to formalize and defend how these constructions result in the desired objects. *For example, copying a segment, copying an angle, bisecting a segment, bisecting an angle, constructing perpendicular lines—including the perpendicular bisector of a line segment, and constructing a line parallel to a given line through a point not on the line.*
10. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle with emphasis on the ability to formalize and defend how these constructions result in the desired objects.

Geometry – Expressing Geometric Properties with Equations

Students will be able to:

1. Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle, prove or disprove that the point* $(1, \sqrt{3})$ *lies on the circle centered at the origin and containing the point* $(0,2)$.
2. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems. *For example, find the equation of a line parallel or perpendicular to a given line that passes through a given point.*
3. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles and connect with the Pythagorean Theorem and the distance formula.

Statistics and Probability – Interpreting Categorical and Quantitative Data

Students will be able to:

1. Represent data with dot plots, histograms, and box plots on the real number line.
2. Use statistics appropriate to the shape of the data distribution to compare center (mean and median) and spread (interquartile range and standard deviation) of two or more different data sets.
3. Interpret differences in shape, center, and spread in the context of the data sets while accounting for possible effects of extreme data points (outliers). Calculate the weighted average of a distribution and interpret it as a measure of center.
4. Represent data on two quantitative variables on a scatter plot and describe how the variables are related including fitting a linear function to the data and using them to solve a problem in context. Emphasis on linear and exponential models. Informally assessing the fit of a

function by plotting and analyzing residuals with emphasis on linear models. Fit a linear function for scatter plots that suggest a linear association.

5. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
6. Use technology to compute and interpret the correlation coefficient of a linear fit.
7. Distinguish between correlation and causation.

Number and Quantity – Vector and Matrix Quantities – HONORS TOPIC

Students will be able to:

1. Recognize vector quantities as having both magnitude and direction and represent vector quantities by directed line segments with appropriate vector symbols ($\boldsymbol{v}, |v|, ||v||, \vec{v}$).
2. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
3. Solve problems involving velocity and other quantities that can be represented by vectors.
4. Add and subtract vectors using end-to-end, component-wise, and parallelogram methods. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes and given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. Understand vector subtraction $\vec{v} - \vec{w}$ as $\vec{v} + (-\vec{w})$ where $-\vec{w}$ is the additive inverse of $\vec{w}$, with the same magnitude as $\vec{w}$ and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order and perform vector subtraction using components.
5. Multiply a vector by a scalar and represent scalar multiplication graphically, by scaling vectors, and using components. Compute the magnitude of a scalar multiple.
6. Use matrices to represent and manipulate data in context.
7. Multiply matrices by scalars to produce new matrices with special attention to context.
8. Add, subtract, and multiply matrices of appropriate dimensions.
9. Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation but still satisfies the associative and distributive properties.
10. Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is non-zero if and only if the matrix has a multiplicative inverse.
11. Multiply a vector (a matrix with one column) by a matrix of suitable dimension to produce another vector. Work with matrices as transformations of vectors.
12. Work with $2x2$ matrices as transformations of the plane and interpret the absolute value of the determinant in terms of area.
13. Solve systems of linear equations up to three variables using matrix row reduction.

Literacy Standards

Students will be able to:

1. Acquire, interpret, and accurately use grade level appropriate mathematical words and terms.

2. Engage in collaborative discussions with diverse partners on grade level concepts.