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Quarter 1

Mathematical Reasoning Skills

Interpret **Analyze** **Create**
Represent **Understand** **Compare**

Essential Standards Spiraled Throughout the Whole Year

CC.2.2.HS.D.1 – *Interpret the structure of expressions to represent a quantity in terms of its context. Limit to linear expressions and to exponential expressions with integer exponents.*

CC.2.2.HS.D.2 – *Write expression in equivalent forms to solve problems. It is important to balance conceptual understanding and procedural fluency in work with equivalent expressions. For example, develop of a skill in factoring and completing the square goes hand-in-hand with understanding what different forms of quadratic expression reveal.*

CC.2.1.HS.F.3 – *Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs and displays. Working with quantities and the relationships between them provides grounding for work with expressions, equations and functions.*

2.1 Numbers and Operations	
The Number System	
CC.2.1.8.E.1 Distinguish between rational and irrational numbers using their properties.	
8.NS.1	Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.
CC.2.1.8.E.4 Estimate irrational numbers by comparing them to rational numbers.	
8.NS.2	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. *Example: What is the estimated value of π^2 ?* *By truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*
The Real Number System	
CC.2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.	
N.RN.3	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. *Connect to physical situations e.g. finding the perimeter of a square of area 2*
2.2 Algebra	
Reasoning with Equations and Inequalities	

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CC.2.2.HS.D.9 Use reasoning to solve equations and justify the solution method – Students should focus on and master A.REI.1 for linear equations and be able to extend and apply their reasoning to other types of equations in future courses. Students will solve exponential equations with logarithms in Algebra II.	
A.REI.1	Understand solving equations as a process of reasoning and explain the reasoning. – ***Master linear; learn as general principle***
A.REI.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. ***Extend earlier work with solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for. Include simple exponential equations that rely on application of the laws of exponents such as $5^2 = 125$ or $2^2 = 1/16$***
Creating Equations	
CC.2.2.HS.D.7 Create equations to describe numbers or relationships. Limit A.CED.1. and A.CED.2 to linear, limit to situations requiring evaluation of exponential functions at integer inputs. Limit A.CED.3 to linear equations and inequalities. Limit ACED.4 to formulas which are linear in the variable of interest.	
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~~. (algebra II)
A.CED.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. – linear only *Example:* *Represent inequalities describing nutritional and cost constraints on combination of different foods.*
A.CED.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *Example:* *Rearrange Ohm's law V=IR to highlight resistance R.*

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Quarter 2

Mathematical Reasoning Skills

Interpret **Analyze** **Create**
Represent **Understand** **Compare**

Essential Standards Spiraled Throughout the Whole Year

CC.2.2.HS.D.1 – *Interpret the structure of expressions to represent a quantity in terms of its context. Limit to linear expressions and to exponential expressions with integer exponents.*

CC.2.2.HS.D.2 – *Write expression in equivalent forms to solve problems. It is important to balance conceptual understanding and procedural fluency in work with equivalent expressions. For example, develop of a skill in factoring and completing the square goes hand-in-hand with understanding what different forms of quadratic expression reveal.*

CC.2.1.HS.F.3 – *Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs and displays. Working with quantities and the relationships between them provides grounding for work with expressions, equations and functions.*

2.2 Algebra

Interpreting Functions

CC.2.2.HS.C1 Understand the concept of a function and use function notation Students should experience a variety of types of situations modeled by functions. Detailed analysis of any class of functions at this stage is not advised. Students should apply these concepts throughout their future courses.

F.IF.1	Understand that a function from one set (called a 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 unput *x.* The graph of *f is the graph of the equation y-F(x).*
F.IF.2	Use the function notation, evaluate functions for inputs in their domain, and interpret statements that use function notation in terms of context.
F.IF.3	Recognize that sequences are functions, sometimes defines recursively, whose domain is a subset of integers.
F.IF.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of quantities, and sketch graphs showing key features given a verbal description of the relationship. ***Key Features; Discrete and continuous, linear to nonlinear, increasing, decreasing, maximum, minimum, intercepts, end behavior, positive and negative y values.***
F.IF.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
F.IF.6	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

CC.2.2.HS.C2 Analyze Functions using different representations. Focus on linear and exponential functions, include comparisons of two functions presented algebraically. For example, compare the growth of two linear functions, or two exponential functions such as $y=3^n$ and $Y = 100^2$.

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F.IF.7	Graph functions expressed symbolically and whole key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima and minima. b. Graph square root, cube root and piecewise-defined functions, including step functions and absolute value functions. ***Compare and contrast absolute value step and piecewise-defined functions with linear, quadratic, and exponential functions. Highlight issues of domain, range, and usefulness when examining piecewise-defined functions.*** e. Graph exponential and logarithmic functions, showing intercepts and end behavior and trigonometric functions, showing period, midline and amplitude.
F.IF.8	Write a function that describes a relationship between two quantities. a. Determine and explicit expression, a recursive process or steps for calculation from a context. b. Combine standard function types using arithmetic operations.
F.1F.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables or by verbal descriptions) ***Focus on expanding the types of functions considered to include, linear, exponential and quadratic.***
2.2 Algebra	
Linear, Quadratic and Exponential Models	
CC.2.2.HS.C6 Interpret expressions for functions in terms of the situation model	
F.LE.5	Interpret parameters in a linear or exponential function in terms of a context. ***Limit exponential functions to those of the form $f(x) = b^x + k$***
Building Functions	
CC.2.2.HS.C3 Build a function that models a relationship between two quantities.	
F.BF.1	Write a function that describes a relationship between two quantities. ***Limit to linear and exponential functions.***
F.BF.1a	Determine an explicit expression, recursive process, or steps for calculation from a context. ***Limit to linear and exponential functions.***
F.BF.1b	Combine standard function types using arithmetic operations. ***Limit to linear and exponential functions.***
F.BF.1b	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations and translate between the two forms. ***Connect arithmetic sequences to linear functions and geometric sequences to exponential functions. .***
F.BF.3	Build new functions form existing functions. Identify the key 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 vale of k given the graphs. Experiment with cases and illustrate an explanation of the effects of the graph using technology. ***Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept. While applying other transformations to a linear graph its appropriate at this level, it may be difficult for students to identify or distinguish between the effects of the other transformations included in the standard.***
F.BF.4	Find inverse functions 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. ***Linear only***

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Quarter 3

Mathematical Reasoning Skills

Interpret **Analyze** **Create**
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Essential Standards Spiraled Throughout the Whole Year

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CC.2.2.HS.D.2 – *Write expression in equivalent forms to solve problems. It is important to balance conceptual understanding and procedural fluency in work with equivalent expressions. For example, develop of a skill in factoring and completing the square goes hand-in-hand with understanding what different forms of quadratic expression reveal.*

CC.2.1.HS.F.3 – *Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs and displays. Working with quantities and the relationships between them provides grounding for work with expressions, equations and functions.*

2.4 Statistics and Probability	
Interpreting Categorical and Interpretative Data	
CC.2.4.HS.B.2 Summarize, represent, and interpret data on two categorical and quantitative variables. Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals.	
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.
S.ID.6	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
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 results.
S.ID.6c	Fit a linear function for a scatter plot that suggest a linear association
CC.2.4.HS.B.3 Interpret Linear Models Build on students' work with linear relationships in 8th grade and introduce the correlation coefficient. The focus here is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and cause-effect relationship arises in S.ID.9	
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.
2.2 Algebra	

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Reasoning with Equations and Inequalities	
CC.2.2.HS.D.10 Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically – Build on student experiences graphing and solving systems of linear equations from middle school to focus on justification of the methods used. Include cases where the two equations descrive the same line (yielding infinitely many solutions) and cases where two equations describe parallel lines (yielding no solution); connect to GPE.5 when it is taught in geometry, which requires students to prove the slope criteria for parallel lines.	
A.REI.5	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. ***Linear-linear and linear-quadratic***
A.REI.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. ***Linear-linear and linear-quadratic***
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). ***Focus on linear and exponential equations and be able to adapt and apply that learning to other types of equations in future courses.***
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.~~ (algebra II) ***Focus on cases where f(x) and g(x) are linear or exponential.***
A.REI.12	Graph the solutions to 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 to a system of linear inequalities in two variables as the intersection of the corresponding half-plane. ***Linear and exponential; learn as general principle***
2.1 Numbers and Operations	
The Real Number System	
CC.2.1.HS.F.1 Apply and extend the properties of exponents to solve problems with rational exponents. These standards should occur before discussing exponential functions with continuous domains.	
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 radical exponents.
N.RN.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
2.4 Statistics and Probability	
Interpreting Categorical and Quantitative Data	
CC.2.2.8.B.3 Analyze and solve linear equations and pairs of simultaneous linear equations	
8.EE.8	Analyze and solve pairs of simultaneous linear equations. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs because points of intersection satisfy both equations simultaneously,
8.EE.8.B	Solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations. Solve simple cases by inspection. *Example:* *3x+2y=5 and 3x+2y=6 have no solultion because 3x=2y cannot simultaneously be 5 and 6.*
8EE.8.C	Solve real-world and mathematical problems leading to two linear equations in two variables.

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Quarter 4

Mathematical Reasoning Skills

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CC.2.1.HS.F.3 – *Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs and displays. Working with quantities and the relationships between them provides grounding for work with expressions, equations and functions.*

2.2 Algebra	
Arithmetic with Polynomials and Rational Expressions	
CC.2.2.HS.D.5 Use polynomial identities to solve problems.	
A.APR.1	Understand that polynomials form a system analogous to the integers, namely they are closed under the operations of addition, subtraction and multiplication; add, subtract and multiply polynomials.
2.3 Geometry	
Pythagorean Theorem	
CC.2.3.8.A.3 Understand and Apply the Pythagorean Theorem to Solve Problems.	
8.G.6	Explain a proof of the Pythagorean Theorem and its converse.
8.G.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
8.G.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
2.4 Statistics and Probability	
Interpreting Categorical and Quantitative Data	
CC.2.4.HS.B.1 Summarize, represent and interpret data on a single count or measurement variable. *In grades 6-8 students describe center and spread in data distribution. Here they choose a summary of statistics appropriate to the characteristics of the data distribution such as the shape of the distribution or existence of extreme data points.*	
S.ID.1	Represent data with plots on the real number line (dot plots, histograms and box plots).

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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 different in shape, center and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).