**Primary Claim**

*Claim #3* - Communicating Reasoning

Students can clearly & precisely construct viable arguments to support their own reasoning & to critique the reasoning of others.

**Secondary Claim**

*Claim #1* – Concepts and Procedures

Students can explain & apply mathematical concepts & carry out mathematical procedures with precision & fluency.

**Domains and Conceptual Categories**

* Counting and Cardinality (CC)
* Operations and Algebraic Thinking (OA)
* Number and Operations in Base Ten (NBT)
* Ratio and Proportional Relationships (RP)
* Expressions and Equations (EE)
* Functions (F)
* Algebra (A)

**Depth of Knowledge (DOK)**

2. Skills/Concepts

**3.** Strategic Thinking

**Standards for math practice**

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. Attend to precision
5. Look for and make use of structure.

**Standard(s)**

**Kindergarten:**

**Counting and Cardinality K.CC**

**Know number names and the count sequence.**

1. Count to 100 by ones and by tens.
2. Count forward beginning from a given number within the known sequence (instead of having to begin at 1).
3. Write numbers from 0 to 20. Represent a number of objects with a written numeral 0–20 (with 0 representing a count of no objects).

**Count to tell the number of objects.**

1. Understand the relationship between numbers and quantities; connect counting to cardinality.
	1. When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object.
	2. Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted.
	3. Understand that each successive number name refers to a quantity that is one larger.
2. Count to answer “how many?” questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration; given a number from 1–20, count out that many objects.

**Operations and Algebraic Thinking K.OA**

**Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.**

1. Represent addition and subtraction with objects, fingers, mental images, drawings, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations.
2. Solve addition and subtraction word problems, and add and subtract within 10, e.g., by using objects or drawings to represent the problem.

**Number and Operations in Base Ten K.NBT**

**Work with numbers 11–19 to gain foundations for place value.**

1. Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or drawings, and record each composition or decomposition by a drawing or equation (e.g., 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones.

**Grade 1:**

**Operations and Algebraic Thinking 1.OA**

**Represent and solve problems involving addition and subtraction.**

1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions.
2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20.

**Add and subtract within 20.**

1. Relate counting to addition and subtraction.
2. Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten; decomposing a number leading to a ten; using the relationship between addition and subtraction; and creating equivalent but easier or known sums.

**Grade 2:**

**Operations and Algebraic Thinking 2.OA**

**Represent and solve problems involving addition and subtraction.**

1. Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions.

 **Add and subtract within 20.**

1. Fluently add and subtract within 20 using mental strategies.2 By end of Grade 2, know from memory all sums of two one-digit numbers.

**Work with equal groups of objects to gain foundations for multiplication.**

**Grade 3:**

**Operations and Algebraic Thinking 3.OA**

**Represent and solve problems involving multiplication and division.**

1. Interpret products of whole numbers.
2. Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities.

**Solve problems involving the four operations, and identify and explain patterns in arithmetic.**

1. Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
2. Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations.

***Grade 4:***

**Operations and Algebraic Thinking 4.OA**

**Use the four operations with whole numbers to solve problems.**

1. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

**Generate and analyze patterns.**

1. Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.

**Grade 5**

**Operations and Algebraic Thinking 5.OA**

**Analyze patterns and relationships.**

1. Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.

**Grade 6:**

**Proportional Relationships 6.RP:**

**Understand ratio concepts and use ratio reasoning to solve problems.**

1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example,*
2. Understand the concept of a unit rate *a/b* associated with a ratio *a : b with b* ≠ *0,* and use rate language in the context of a ratio relationship.
3. Use ratio and rate reasoning to solve real-world and mathematical problems.
	1. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
	2. Solve unit rate problems including those involving unit pricing and constant speed.
	3. Find a percent of a quantity as a rate per 100; solve problems involving finding the whole, given a part and the percent.

**Expressions and Equations 6.EE**

**Represent and analyze quantitative relationships between dependent and independent variables.**

9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

**Grade 7:**

**Proportional Relationships 7.RP:**

**Analyze proportional relationships and use them to solve real-world and mathematical problems.**

1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.
2. Recognize and represent proportional relationships between quantities.
	1. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
	2. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
	3. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.*
	4. Explain what a point *(x, y)* on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r)* where *r* is the unit rate.
3. Use proportional relationships to solve multistep ratio and percent problems.

**Expressions and Equations 7.EE**

**Use properties of operations to generate equivalent expressions.**

1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related.

**Solve real-life and mathematical problems using numerical and algebraic expressions and equations.**

1. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
2. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
	1. Solve word problems leading to equations of the form *px + q = r* and *p(x + q) = r,* where *p, q,* and *r* are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.
	2. Solve word problems leading to inequalities of the form *px + q > r* or *px + q < r,* where *p, q,* and *r* are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem.

**Grade 8:**

**Expressions and Equations 8.EE**

**Understand the connections between proportional relationships, lines, and linear equations.**

1. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*
2. Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation *y = mx* for a line through the origin and the equation *y = mx + b* for a line intercepting the vertical axis at *b.*

**Analyze and solve linear equations and pairs of simultaneous linear equations.**

1. Solve linear equations in one variable.
	1. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. 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).
	2. Solve linear equations with rational number coefficients, including equations whose solutions require
2. Analyze and solve pairs of simultaneous linear equations.
	1. 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.
	2. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.
	3. Solve real-world and mathematical problems leading to linear equations in two variables.

**Functions 8.F**

**Define, evaluate, and compare functions.**

1. 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.
2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*
3. 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.

**Use functions to model relationships between quantities.**

1. 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. 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.
2. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

**High School**

**Algebra: Seeing Structure in Expressions A-SSE**

**Interpret the structure of expressions**

1. Interpret expressions that represent a quantity in terms of its context.★
	1. Interpret parts of an expression, such as terms, factors, and coefficients.
	2. Interpret complicated expressions by viewing one or more of their parts as a single entity.
2. Use the structure of an expression to identify ways to rewrite it.

**Write expressions in equivalent forms to solve problems**

1. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★

**Creating Equations★ A-CED**

**Create equations that describe numbers or relationships**

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.*
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

**Reasoning with Equations and Inequalities A-REI**

**Understand solving equations as a process of reasoning and explain the reasoning**

1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

**Solve equations and inequalities in one variable**

1. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

**Solve systems of equations**

1. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

**Functions**

**Interpreting Functions F-IF**

**Understand the concept of a function and use function notation**

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*).
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.

**Interpret functions that arise in applications in terms of the context**

1. 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.*★
2. 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.*★
3. 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.★

**Analyze functions using different representations**

1. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★
	1. Graph linear and quadratic functions and show intercepts, maxima, and minima.
2. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
3. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

**Building Functions F-BF**

**Build a function that models a relationship between two quantities**

1. Write a function that describes a relationship between two quantities.★
	1. Determine an explicit expression, a recursive process, or steps for calculation from a context.
	2. Combine standard function types using arithmetic operations.
	3. (+) Compose functions