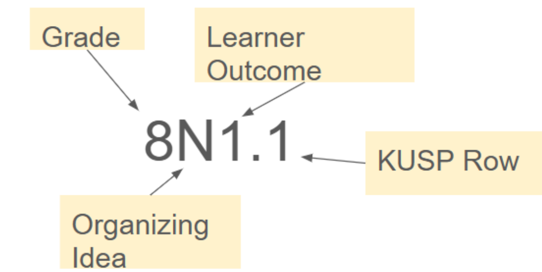
# Draft Mathematics 7–9 Curriculum

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| **Organizing Idea** | Number: Numbers are organized into systems with unique notation to communicate quantities and to facilitate calculations. | | | | | | | | |
| **Guiding Question** | How can the symmetry of the number line contribute to a sense of number? | | | How can the density of the number line contribute to a sense of number? | | | How can shared properties of numbers be communicated? | | |
| **Learning Outcome** | 7N1 Students analyze positive and negative numbers. | | | 8N1.1 Students interpret rational and irrational numbers. | | | 9N1 Students analyze sets of real numbers. | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | Absolute value represents the magnitude of any number from zero.<br><br>A negative fraction can be expressed equivalently as - $\frac{a}{b}$, $\frac{-a}{b}$ or $\frac{a}{-b}$ for any two positive numbers *a* and *b*.<br>Negative decimal numbers can be found in real-world situations, such as<br>• debt<br>• change in stock prices<br>• sea levels<br>• Temperature | Every fraction and decimal number has an additive inverse with the same absolute value and opposite sign. | Relate the absolute value of positive and negative numbers, including decimal numbers and fractions, to their positions on the number line.<br><br>Convert between fractions and decimal numbers, including negative numbers.<br><br>Compare and order positive and negative numbers, including decimal numbers and fractions.<br><br>Discuss real-world situations involving negative decimal numbers. | The set of real numbers includes the sets of rational numbers and irrational numbers.<br><br>A rational number can be expressed as the quotient of two integers, $\frac{a}{b}$ where $b \neq 0$.<br><br>Rational numbers are terminating or repeating decimal numbers.<br><br>A repeating decimal, represented with a segment over the repeating digit(s), is a decimal number that contains a digit or group of digits that repeat endlessly.<br><br>The set of rational numbers includes the sets of natural numbers and integers.<br><br>The conventional order of operations applies to | There are infinitely many rational numbers between any two rational numbers on the number line. | Express rational numbers as fractions and decimal numbers.<br><br>Classify natural numbers, integers, and rational numbers.<br><br>Relate a rational number to its position on the number line.<br><br>Compare and order rational numbers.<br><br>Determine a rational number between any two given rational numbers.<br><br>Investigate fractions that result in repeating decimals.<br><br>Add, subtract, multiply, and divide any two rational numbers.<br><br>Assess the reasonableness of a sum, difference, product, or quotient, using estimation. | A set is a collection of elements of any nature.<br><br>A set can be defined by listing its elements symbolically in braces, e.g., $A = \{2, 4, 6, 8\}$.<br><br>Each element in a set is only listed once, and the order of the elements does not matter.<br><br>A set may be finite or infinite.<br><br>Two sets are equal if they have the same elements.<br><br>In two sets, $A$ and $B$, if every element in $A$ is also in $B$, then $A$ is a subset of $B$, represented symbolically as $A \subseteq B$.<br><br>The empty set contains no elements and can be represented symbolically as $\varnothing$. | The organization of numbers into sets facilitates interpretation of relationships. | Represent the elements of a set of numbers, including the empty set.<br><br>Describe a set of numbers as finite or infinite.<br><br>Justify whether a set of numbers is a subset of another.<br><br>Represent natural, integer, rational, and irrational number subsets of real numbers.<br><br>Identify the subsets to which a real number belongs. |

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| | | | | operations on rational numbers. | | Evaluate numerical expressions involving rational numbers according to the order of operations.<br><br>Solve problems involving rational numbers in real-world situations. | If an element, $x$, belongs to the set $A$, it is represented symbolically as $x \in A$.<br><br>If an element, $x$, does not belong to the set $A$, it is represented symbolically as $x \notin A$.<br><br>Sets can be represented with diagrams, including Venn diagrams.<br><br>A set of numbers can be represented by a symbol, including<br>• $\mathbb{N}$ for natural numbers<br>• $\mathbb{Z}$ for integers<br>• $\mathbb{Q}$ for rational numbers<br>• $\overline{\mathbb{Q}}$, $\mathbb{Q}^c$, or $\mathbb{Q}'$ for irrational numbers<br>• $\mathbb{R}$ for real numbers | | |

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| **Learning Outcome** | | | | **Learning Outcome** 8N1.2 Students interpret rational and irrational numbers. | | | | | |
| | | | | An irrational number is a real number that is not rational.<br><br>An irrational number cannot be expressed as the quotient of two integers, $\frac{a}{b}$.<br><br>Irrational numbers are non-terminating, non-repeating decimal numbers.<br><br>The approximate value of an irrational number can be expressed by using a rounded decimal number.<br><br>An irrational number can be expressed as an exact value, such as $\sqrt{2}$ or $\pi$. | Irrational numbers fill the gaps between rational numbers on the number line. | Distinguish between rational numbers and irrational numbers.<br><br>Classify the expression of an irrational number as exact or approximate.<br><br>Approximate an irrational number as a rounded decimal.<br><br>Express an irrational number as an exact value.<br><br>Relate an irrational number to its approximate position on the number line.<br><br>Compare and order real numbers. | | | |

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| **Organizing Idea** | Number: Numbers are organized into systems with unique notation to communicate quantities and to facilitate calculations. | | | | | | | | |
| **Guiding Question** | How can operations on positive and negative numbers be understood? | | | | | | | | |
| **Learning Outcome** | 7N2.1 Students apply operations to positive and negative numbers. | | | **No N2 in grade 8 to match 7N2 progression** | | | **No N2 n Grade 9 to match 7N2 progression** | | |
| | Knowledge | Understanding | Skills & Procedures | | | | | | |
| | The symbol, −, can indicate a negative number or the subtraction operation.<br><br>Addition does not always result in a greater number, and subtraction does not always result in a smaller number.<br><br>Subtraction can be expressed as addition, i.e., $a - b = a + (-b)$.<br><br>Addition and subtraction of positive and negative numbers can be supported by various processes for adding and subtracting decimal numbers and fractions, such as<br>• employing standard algorithms<br>• determining common denominator<br>• expressing subtraction as related addition | Addition and subtraction of integers can be represented as numerical expressions. | Distinguish the meaning of the symbol, −, represented in a numerical expression.<br><br>Add and subtract any two integers.<br><br>Assess the reasonableness of a sum or difference of two integers.<br><br>Solve problems involving addition and subtraction of integers. | | | | | | |

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| **Learning Outcome** | 7N2.2 Students apply operations to positive and negative numbers. | | | | | | | | |
| | The product or quotient of<br>• two positive numbers is positive<br>• two negative numbers is positive<br>• a negative number and a positive number is negative<br><br>Multiplication can be represented symbolically in various ways, i.e., $a \times b$, $a \cdot b$, $a(b)$, and $(a)(b)$.<br><br>Any negative number can be expressed as the product of its inverse and $-1$, i.e., $-a = -1(a)$. | Products and quotients can be represented as numerical expressions in infinitely many ways. | Multiply and divide any two integers.<br><br>Investigate whether a product or quotient of three or more integers will be positive or negative.<br><br>Create various expressions of the same product, using positive and negative factors.<br><br>Assess the reasonableness of a product or quotient of integers.<br><br>Solve problems involving multiplication and division of integers. | | | | | | |

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| **Organizing Idea** | Number: Numbers are organized into systems with unique notation to communicate quantities and to facilitate calculations. | | | | | | | | |
| **Guiding Question** | How can different representations provide new perspectives of squares and cubes? | | | In what ways can rational and irrational numbers support interpretation of roots and powers? | | | How can powers efficiently communicate number? | | |
| **Learning Outcome** | 7N.3.1 Students interpret perfect squares and perfect cubes. | | | 8N3 Students interpret square roots of perfect and non-perfect squares. | | | 9N3.1 Students analyze exponent laws and powers of 10. | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | The product of two identical factors is a perfect square.<br><br>A perfect square can be represented as a power with the exponent two, i.e., $a^2$.<br><br>The square root of a perfect square is one of the two identical factors and can be expressed symbolically by using a radical sign, $\sqrt{\square}$.<br><br>A perfect square can be represented by the area of a square, while the side length can be expressed as a square root. | A square can be interpreted as a number and as a shape. | Identify the base and exponent in a perfect square.<br><br>Express a perfect square as repeated multiplication and a power.<br><br>Recall perfect squares within 144 and their square roots, limited to natural numbers.<br><br>Solve problems involving perimeter and area of squares, limited to side lengths that are natural numbers. | A non-perfect square is the product of two identical irrational numbers.<br><br>Every positive real number has exactly two square roots, one positive and one negative.<br><br>Zero is the only real number that has exactly one square root.<br><br>Negative real numbers do not have square roots that are real numbers.<br><br>The equation $x^2 = a$ has two solutions, $\sqrt{a}$ and $-\sqrt{a}$.<br><br>The radical sign, $\sqrt{\square}$, is the conventional notation that indicates the positive square root (principal square root) of a number.<br><br>The radical sign with a negative sign in front, $-\sqrt{\square}$, indicates the negative square root of a number (secondary square root).<br><br>The notation $x = \pm\sqrt{a}$ indicates $x = +\sqrt{a}$ or $x = -\sqrt{a}$.<br><br>The radical sign is used to express the exact value of a square root of a non-perfect | Square roots can be explained with rational numbers and irrational numbers. | Classify positive rational numbers as perfect squares or non-perfect squares.<br><br>Express perfect and non-perfect squares as repeated multiplication and as powers.<br><br>Justify the number of square roots of real numbers, including zero.<br><br>Approximate the square roots of non-perfect squares, within 144.<br><br>Determine the area of a square, given the side length.<br><br>Determine the side length of a square, given its area.<br><br>Solve problems involving perimeter and area of squares. | Parentheses can be used to indicate the base of a power, including negative bases.<br><br>Expressions that include powers can be simplified by applying the exponent laws:<br>• product of powers<br>$a^m \times a^n = a^{m+n}$<br>• quotient of powers<br>$a^m \div a^n = a^{m-n}$<br>• power of a power<br>$(a^m)^n = a^{mn}$<br>• power of a product<br>$(ab)^n = a^n b^n$<br>• power of a quotient<br>$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0$<br>• zero exponent<br>$a^0 = 1$<br>• negative exponent<br>$a^{-n} = \frac{1}{a^n}, a \neq 0$ | Exponent laws ensure equivalence of expressions that include powers. | Investigate the role of parentheses in powers.<br><br>Justify exponent laws, using repeated multiplication.<br><br>Justify the zero exponent law.<br><br>Justify the negative exponent law.<br><br>Simplify expressions that include powers, using exponent laws limited to integer values for $a, b, m, n$. |

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| | | | | square, e.g., $\sqrt{2}$.<br><br>A rounded decimal number can express the approximate value of a square root.<br><br>The approximate value of a square root of a non-perfect square can be determined by using perfect squares as benchmarks.<br><br>A non-perfect square can be represented by the area of a square, while side length can be expressed as an approximate or exact value. | | | | | |
| **Learning Outcome** | **Learning Outcome**<br>7N.3.2 Students interpret perfect squares and perfect cubes. | | | | | | **Learning Outcome**<br>9N3.2 Students analyze exponent laws and powers of 10. | | |
| | The product of three identical positive factors is a perfect cube.<br><br>A perfect cube can be represented as a power with the exponent three, i.e., $a^3$.<br><br>The cube root of a perfect cube is one of the three identical natural number factors and can be expressed symbolically by using a radical sign, $\sqrt[3]{\square}$.<br><br>The volume of a cube can be represented by a perfect cube, while the length of an edge can be expressed as a cube root. | A cube can be interpreted as a number and as a shape. | Identify the base and exponent in a perfect cube.<br><br>Express a perfect cube as repeated multiplication and a power.<br><br>Recall perfect cubes within 125 and their cube roots, limited to natural numbers.<br><br>Solve problems involving volume of cubes, limited to edge lengths that are natural numbers. | | | | Powers of 10 correspond to places defined by the base-10 system.<br><br>A power of 10 with a negative exponent can be interpreted with the negative exponent law.<br><br>Scientific notation expresses a number as the product of a positive decimal number between 1 and 10 or a negative decimal number between −1 and −10 and a power of 10.<br><br>Scientific notation can be found in real-world situations, such as<br>• distances in space<br>• number of atoms<br>• size of a bacteria | Powers of 10 can facilitate the expression of very small and very large magnitudes. | Investigate the relationship between powers of 10 and place value.<br><br>Express a power of 10 as a decimal number and as a fraction.<br><br>Express numbers of very large and very small magnitude, using scientific notation.<br><br>Convert between scientific notation and decimal numbers.<br><br>Discuss scientific notation in real-world situations. |

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| **Organizing Idea** | Number: Numbers are organized into systems with unique notation to communicate quantities and to facilitate calculations. | | | | | | | | |
| **Guiding Question** | How can multiplication and division be generalized? | | | | | | | | |
| **Learning Outcome** | 7N4.1 Students interpret multiplication and division of positive fractions and of positive decimal numbers. | | | **No 8N4 to match 7N4 progression** | | | **No 9N4 to match 7N4 progression** | | |
| | Knowledge | Understanding | Skills & Procedures | | | | | | |
| | The product of two fractions is the fraction resulting from multiplication of the numerators and multiplication of the denominators, i.e., $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$ and can be applied to real-world situations such as adjusting recipes.<br><br>Multiplication of two fractions can be represented by a model, e.g., an area model.<br><br>The product of two proper fractions is less than its factors.<br><br>A proper fraction is a fraction in which the numerator is less than the denominator.<br><br>The product of two fractions is equivalent to the product of any equivalent forms of those fractions. | The product of two fractions can be interpreted as part of a part. | Model multiplication of fractions.<br><br>Relate the product of a fraction by a fraction to part of a part.<br><br>Multiply two fractions.<br><br>Compare products of fractions in various equivalent forms, including simplest form.<br><br>Solve problems involving multiplication of two fractions. | | | | | | |

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| **Learning Outcome** | 7N4.2 Students interpret multiplication and division of positive fractions and of positive decimal numbers. | | | **No 8N4 to match 7N4 progression** | | | **No 9N4 to match 7N4 progression** | | |
| | Division by a fraction is equivalent to multiplication by its reciprocal, i.e.,<br>$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$<br><br>and<br>$a \div \frac{b}{c} = a \times \frac{c}{b} = \frac{ac}{b}$<br>and can be applied to real-world situations such as sharing food and cutting materials.<br><br>A reciprocal is the multiplicative inverse of a fraction.<br><br>The product of a fraction and its reciprocal is 1.<br><br>The quotient of a number and a proper fraction is greater than the number.<br><br>Division of two fractions can be facilitated by representing the fractions with common denominators.<br><br>The quotient of two fractions with common denominators is the quotient of the two numerators, i.e.<br>$\frac{a}{b} \div \frac{c}{b} = \frac{a}{c}$ | The quotient of any quantity and a fraction can be interpreted as the number of fraction-sized groups that compose the quantity. | Relate a number to its reciprocal.<br><br>Prove that multiplication of a fraction and its reciprocal is 1.<br><br>Divide a natural number by a fraction and vice versa.<br><br>Divide a fraction by a fraction.<br><br>Investigate the composition of a quantity by fraction-sized groups.<br><br>Solve problems involving division of two fractions. | | | | | | |

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| **Learning Outcome** | 7N4.3 Students interpret multiplication and division of positive fractions and of positive decimal numbers. | | | | | | | | |
| | Multiplication and division of a decimal number by a decimal number can be supported by processes, such as<br>• expressing decimal numbers as fractions<br>• using standard algorithms<br>• using area models<br><br>Equivalent division expressions can be created when dividing decimal numbers by multiplying the divisor and dividend by the same factor. | Equivalent expressions can facilitate multiplication and division of decimal numbers. | Multiply and divide decimal numbers, including dividing a natural number by a decimal number.<br><br>Solve problems involving decimal numbers, including in real-world situations. | | | | | | |
| **Learning Outcome** | 7N4.4 Students interpret multiplication and division of positive fractions and of positive decimal numbers. | | | | | | | | |
| | The conventional order of operations applies to integers, fractions, and decimal numbers. | | | | | | | | |

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| **Organizing Idea** | Number: Numbers are organized into systems with unique notation to communicate quantities and to facilitate calculations. | | | | | | | | |
| **Guiding Question** | In what ways can proportional relationships be characterized? | | | How can proportional reasoning support problem solving? | | | | | |
| **Learning Outcome** | 7N5 Students analyze multiplicative relationships between equivalent ratios. | | | 8N5 Students analyze multiplicative relationships within ratios. | | | **No 9N5 to match 7 and 8 progression** | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | | | |
| | The terms of a ratio can be any numbers, including integers, decimal numbers, or fractions.<br><br>The first term of a ratio can be less than or greater than the second term.<br><br>A ratio can be iterated by multiplying both terms by the same factor, e.g., $\frac{a}{b} = \frac{5a}{5b}$<br><br>A ratio can be partitioned by dividing both terms by the same factor, e.g.<br>$a : b = \frac{a}{4} : \frac{b}{4}$<br><br>Equivalent ratios are related by a factor.<br><br>The factor relating equivalent ratios can be a natural number, decimal number, or fraction.<br><br>A proportional relationship expressed as $\frac{a}{b} = \frac{c}{d}$ is equivalent to $ad = bc$.<br><br>The first terms and the second terms of two equivalent ratios can be added or subtracted, respectively, to generate another equivalent ratio. | Multiplicative relationships are foundational to proportional reasoning. | Generate equivalent ratios by iterating or partitioning a ratio.<br><br>Determine the factor that relates equivalent ratios.<br><br>Determine an unknown value related to a given equivalent ratio.<br><br>Generate an equivalent ratio, using two existing equivalent ratios.<br><br>Compare two ratios that have common first or second terms.<br><br>Determine a percentage of a natural number by iterating or partitioning benchmark percentages.<br><br>Determine percentages of natural numbers less than 1% and greater than 100%.<br><br>Solve problems involving proportional reasoning in real-world situations. | A multiplicative comparison describes the multiplicative relationship between one quantity and another.<br><br>Either of the quantities in a multiplicative comparison can be described as a multiple of the other.<br><br>The factor that relates two quantities in a ratio is the constant of proportionality, $k$.<br><br>When quantity $a$ in ratio $a : b$ is directly proportional to quantity $b$, $k = \frac{a}{b}$<br><br>When quantity $a$ in ratio $a : b$ is inversely proportional to quantity $b$, $k = ab$.<br><br>A constant of proportionality can be expressed as a decimal number and a ratio, and is the same for any equivalent ratios.<br><br>A constant of proportionality can be referred to by various names, depending on the context, including<br>• slope<br>• unit rate<br>• scale factor | A ratio can be interpreted as a multiplicative comparison. | Describe one quantity in a ratio as a multiple of the other.<br><br>Determine the constant of proportionality for a given ratio.<br><br>Generate equivalent ratios for a given constant of proportionality.<br><br>Determine the missing quantity in a ratio, given the constant of proportionality.<br><br>Solve problems that involve quantities related by a constant of proportionality, including in real-world situations. | | | |

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| | Equal first terms or equal second terms can facilitate the comparison of ratios.<br><br>A percentage can be represented as a ratio, i.e., $\frac{a}{b} = \frac{x}{100}$<br><br>A ratio can be converted into a percentage by multiplying by 100.<br><br>A percentage can be interpreted as a sum of benchmark percentages, including 1%, 5%, 10%, 25%, 50%.<br><br>A percentage can be less than 1% or greater than 100%.<br><br>Proportional reasoning can be applied in real-world situations, including<br>• discounts<br>• percent increase/ decrease<br>• taxes<br>• scaling recipes<br>• unit rates<br>• converting between units | | | | | | | | |

# Draft Mathematics 7–9 Curriculum

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| **Organizing Idea** | Algebra: Generalizing arithmetic with expressions, equations, and inequalities supports problem solving in real-world situations. | | | | | | | | |
| **Guiding Question** | | | | How can powers be generalized? | | | How can arithmetic operations be generalized? | | |
| **Learning Outcome** | **No 7A1 to match 8 and 9 Algebra Progression** | | | 8A1 Students interpret powers in single-variable algebraic terms. | | | 9A1 Students interpret arithmetic operations, using single-variable polynomials. | | |
| | | | | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | | | | An algebraic term is the product of a coefficient and a power.<br><br>An algebraic term is also called a monomial.<br><br>A polynomial is the sum of monomials in which<br>• the coefficients are real numbers<br>• the exponent of the variable in each term is a natural number<br><br>A power of a variable represents a product of several copies of the variable.<br><br>The conventional representation of an algebraic term with a coefficient of one is a variable without a coefficient, e.g., $1x^2 = x^2$.<br><br>The conventional representation of a linear term is a term without the exponent, e.g., $x^1 = x$.<br><br>The conventional representation of a constant term is a number without a variable, e.g., $5x^0 = 5$.<br><br>Polynomials can be classified according to the number of algebraic terms, i.e.,<br>• Monomials have one term. | A polynomial is built by using operations of addition, subtraction, and multiplication. | Express an algebraic term as multiplication of a coefficient and variable factors and vice versa.<br><br>Justify that an algebraic expression is a polynomial.<br><br>Express algebraic terms, using conventional representations.<br><br>Classify a polynomial according to number of terms.<br><br>Relate the value of the exponent in an algebraic term to the degree of the algebraic term.<br><br>Name algebraic terms according to degree.<br><br>Determine the degree of a polynomial.<br><br>Express a polynomial with terms in descending or ascending order according to degree.<br><br>Add and subtract monomials by combining like terms. | Exponent laws can be applied to determine the product or quotient of two monomials.<br><br>Expanding is the process of multiplying polynomials according to the distributive property.<br><br>Factoring is the process of expressing a polynomial as a product of its factors.<br><br>Expanding and factoring polynomials are inverse processes.<br><br>A polynomial in which all terms share a common factor can be expressed as the product of the common factor and a polynomial factor by applying exponent laws.<br><br>Identities relate the expanded and factored form of a polynomial, including<br>$(a + b)^2 = a^2 + 2ab + b^2$<br>$(a - b)^2 = a^2 - 2ab + b^2$<br><br>The difference of squares identity can relate a polynomial to its factored form,<br>$a^2 - b^2 = (a - b)(a + b)$<br><br>Not all polynomials can be factored. | Polynomial operations generate equivalent expressions. | Multiply monomials.<br><br>Expand and simplify two polynomials with three terms or less.<br><br>Factor polynomial expressions involving common factors.<br><br>Factor polynomials in the form $x^2 + bx + c$.<br><br>Factor polynomial expressions, using difference of squares, limited to integer numbers.<br><br>Justify the factors of a polynomial through expansion.<br><br>Determine when a polynomial is non-factorable. |

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| | | | | • Binomials have two terms.<br>• Trinomials have three terms.<br><br>The value of the exponent in an algebraic term is called the degree of the algebraic term, e.g., $x^2$ has a degree of 2.<br><br>The degree of a polynomial is the greatest degree of any of its algebraic terms.<br><br>Polynomials can be named according to degree, i.e.,<br>• Degree of 1 is linear.<br>• Degree of 2 is quadratic.<br>• Degree of 3 is cubic.<br>• Degree of $n$ is a polynomial.<br><br>A constant term is equivalent to an algebraic term that has a degree of zero.<br><br>Algebraic terms with the same variable and the same degree are like terms.<br><br>The conventional representation of a polynomial is writing algebraic terms in descending order of degree.<br><br>Adding and subtracting polynomials involves combining like terms.<br><br>Subtracting a polynomial is the same as adding its additive inverse. | | | | | |

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| **Organizing Idea** | Algebra: Generalizing arithmetic with expressions, equations, and inequalities supports problem solving in real-world situations. | | | | | | | | |
| **Guiding Question** | How can equivalence provide new perspectives of equations? | | | In what ways can flexibility with numbers facilitate the process of solving equations? | | | In what ways can multiple solutions be explained? | | |
| **Learning Outcome** | 7A2 Students apply equivalence to solving linear equations. | | | 8A2 Students solve single-variable linear equations involving rational numbers. | | | 9A2 Students solve single-variable simple quadratic equations. | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | Simplifying algebraic expressions on one or both sides of an equation results in an equivalent equation.<br><br>Algebraic expressions can be simplified by applying algebraic properties and by combining like terms.<br><br>Adding or subtracting the same algebraic or constant term on both sides of an equation results in an equivalent equation.<br><br>A solution is a value that, when substituted into the equation, satisfies the equation. | Equations can be expressed in infinitely many equivalent ways. | Simplify algebraic expressions on one or both sides of an equation, using algebraic properties, including the distributive property.<br><br>Solve linear equations with algebraic terms on both sides of the equation.<br><br>Verify the solution to a linear equation by substituting the solution into any equivalent equation.<br><br>Solve problems involving real-world situations, using linear equations. | Multiplying or dividing both sides of an equation by the same number results in an equivalent equation.<br><br>An equation including rational numbers can be expressed as an equivalent equation with integers, e.g., $(\frac{1}{2})x + 3 = 5$ can be expressed as $x + 6 = 10$. | Any factor or multiple of an equation is an equivalent equation. | Express an equation with rational coefficients as an equivalent equation with integers.<br><br>Solve equations with rational coefficients.<br><br>Solve problems, using equations with rational coefficients.<br><br>Solve linear equations, including with parentheses and variables on both sides of the equation. | Every linear equation has exactly one solution.<br><br>Quadratic equations can have two, one, or zero solutions.<br><br>The two solutions for a quadratic equation in the form $x^2 = a$, where $a > 0$, are $\sqrt{a}$ and $-\sqrt{a}$.<br><br>Quadratic equations can be applied in real-world situations, including determining the side length of a square, given its area. | An equation can have multiple solutions. | Determine the number of solutions for a quadratic equation in the form $x^2 = a$ for values of $a$ less than, greater than, and equal to 0.<br><br>Solve quadratic equations in the form $x^2 = a$, including in real-world situations.<br><br>Solve quadratic equations in the form $x^2 + c = 0$, where $c$ is an integer. |

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| **Organizing Idea** | Algebra: Generalizing arithmetic with expressions, equations, and inequalities supports problem solving in real-world situations. | | | | | | | | |
| **Guiding Question** | | | | In what ways can multiple values be generalized? | | | In what ways can solutions to inequalities be interpreted? | | |
| **Learning Outcome** | | | | 8A3 Students interpret inequalities. | | | 9A3 Students define solutions to single-variable linear inequalities. | | |
| | | | | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | | | | An inequality is a relation that represents a comparison of two numbers or expressions, which may include a variable.<br><br>The solution of an inequality is a range of values that satisfies the inequality.<br><br>An inequality can be expressed by using words or symbols.<br><br>A strict inequality describes values as "less than," <, or "greater than," >, a given number.<br><br>A non-strict inequality describes values as "less than or equal to," ≤, or "greater than or equal to," ≥, a given number, i.e., $x \geq a$, indicates $x > a$ or $x = a$.<br><br>An inequality can be modelled on the number line by using a ray extending to the right for values greater than and to the left for values less than the given number.<br><br>On the number line, the given number is indicated with an open dot, ○, for strict inequalities and with a closed dot, ●, for non-strict inequalities. | An inequality can describe the unequal relationship between all possible values of a variable and a number. | Identify an inequality as strict or non-strict.<br><br>Model inequalities on the number line.<br><br>Verify, by substitution, whether a number is a solution of an inequality.<br><br>Represent a real-world situation as an inequality. | When solving an inequality, the solution set can form a range of values.<br><br>Simplifying algebraic expressions on both sides of an inequality can facilitate solving the inequality.<br><br>An inequality can be solved by applying the same operations to expressions on both sides of the inequality, according to the properties of inequalities, including<br>• if $a < b$, then $a + c < b + c$ for any real numbers $a$, $b$, and $c$ (addition property)<br>• if $a < b$, then $ac < bc$ for any real numbers $a$, $b$, and $c$, where $c > 0$ (multiplication property)<br>• if $a < b$, then $ad > bd$ for any real numbers $a$, $b$, and $d$, where $d < 0$ (multiplication property)<br><br>The set of all solutions of an inequality is the solution set.<br><br>Solutions to inequalities can be represented in various ways, including with set-builder notation.<br><br>Set-builder notation can represent a solution set as an | An inequality can describe the relationship between two unequal algebraic expressions. | Solve single-variable linear inequalities.<br><br>Determine whether a number is a solution to an inequality.<br><br>Relate various representations of the solution set for an inequality.<br><br>Represent the solution set for an inequality on the number line.<br><br>Represent the solution set for an inequality, using set-builder notation.<br><br>Solve problems by using inequalities, including in real-world situations. |

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| | | | | Inequalities can describe real-world situations, such as<br>• speed limits<br>• height restrictions<br>• age restrictions | | | algebraic expression inside braces or as a statement, e.g., $S$ : $\{x \mid x \le -1, x \in \mathbb{Z}\}$ “S is the set of all numbers, $x$, such that $x$ is less than or equal to $-1$, and $x$ is an element of the integers." | | |

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| **Organizing Idea** | Geometry: The properties of geometric objects are explained through justification and proof. | | | | | | | | |
| **Guiding Question** | In what ways can geometric objects be interpreted? | | | In what ways can similarity refine reasoning about geometric objects? | | | How can geometric relationships be verified? | | |
| **Learning Outcome** | 7G1.1 Students analyze the structure and relationships of geometric objects. | | | 8G1.1 Students interpret similarity through scale factor. | | | 9G1.1 Students analyze relationships between triangles. | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | Geometric objects are abstract mathematical concepts and include<br>• straight lines<br>• rays<br>• line segments<br>• angles<br>• polygons<br><br>A straight line can be interpreted as a series of adjacent points that extends infinitely in two opposite directions.<br><br>A ray is the portion of a straight line that extends infinitely in one direction from a given point on the line.<br><br>A line segment is the portion of a straight line between two given points.<br><br>An angle is formed by two straight lines, line segments, or rays that share a vertex.<br><br>A polygon is a closed figure made of three or more line segments that only intersect at the vertices.<br><br>Symbolic notation can be used to communicate geometric objects, including<br>• straight lines, e.g., $\overleftrightarrow{CD}$ or a single lower case letter<br>• rays, e.g., $\overrightarrow{AC}$<br>• line segments, e.g., | Symbols and symbolic notation can be used to represent relationships between geometric objects. | Differentiate between straight lines, rays, line segments, angles, and polygons.<br><br>Model geometric objects, using hands-on materials or a digital geometry environment.<br><br>Identify straight lines, rays, line segments, angles, and triangles, using symbols and symbolic notation.<br><br>Represent relationships between geometric objects, using symbols and symbolic notation. | Geometric objects are similar if one may be obtained from the other by using a scale factor or rotation.<br><br>All circles are similar and all squares are similar.<br><br>Rectangles are similar if they have the same ratio of the longer side to the shorter side.<br><br>The scale factor is the result of dividing the scale drawing length by the corresponding original object length, when lengths are in the same units.<br><br>The scale factor represents the ratios of the corresponding lengths in similar geometric objects, resulting in a similar object being<br>● enlarged when the scale factor is $>1$<br>● reduced when the scale factor is $>0$ and <1.<br>● maintained when the scale factor is $1$. | Similarity of geometric objects can be explained with proportions. | Determine the scale factor of similar geometric objects.<br><br>Determine whether geometric objects are similar, given a scale factor.<br><br>Solve problems involving areas of similar geometric objects.<br><br>Solve problems involving scale factor in real-world situations. | The congruence of two triangles can be verified when the triangles meet one of the three properties of triangle congruence:<br>• Side-Side-Side: the three pairs of corresponding sides are equal<br>• Side-Angle-Side: two pairs of corresponding sides and the included angles are equal<br>• Angle-Side-Angle: two pairs of corresponding angles and the included sides are equal<br><br>Symbolic notation can be used to represent congruence of triangles, including through<br>• a congruence statement, e.g.,<br>$\triangle ABC \cong \triangle RST$<br>• equal sides, e.g.,<br>$\overline{AB} = \overline{RS}$<br>$\overline{BC} = \overline{ST}$<br>$\overline{AC} = \overline{RT}$<br>• equal angles, e.g.,<br>$\angle ABC = \angle RST$<br>$\angle BCA = \angle STR$<br>$\angle CAB = \angle TRS$ | Congruence and similarity of triangles can be verified by using criteria. | Model congruent and similar triangles, using hands-on materials or a digital geometry environment.<br><br>Verify the three properties of triangle congruence.<br><br>Justify the congruence of two triangles, using the properties of triangle congruence.<br><br>Represent congruence of two triangles, using symbolic notation.<br><br>Determine the three pairs of equal sides and three pairs of equal angles, given the congruence statement for two triangles.<br><br>Justify triangle theorems, using hands-on materials or a digital geometry environment.<br><br>Verify the properties of triangle similarity.<br><br>Justify the similarity of two triangles, using the properties of triangle similarity.<br><br>Write a similarity statement for two similar triangles. |

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| | | | | The scale factor that relates the areas of two similar objects is the square of the scale factor that relates the side lengths.<br><br>Scale factors appear in real-world situations, such as<br>• maps | | | Similar triangles can be determined by using theorems, including<br>• a line parallel to one side of a triangle that intersects the other two sides divides the other two sides proportionally and creates a smaller triangle similar to the original triangle (triangle proportionality theorem)<br>• a line segment drawn perpendicular to the hypotenuse of a right triangle from the right angle creates two smaller right triangles that are similar to the original triangle (altitude theorem)<br><br>The similarity of two triangles can be verified when the triangles meet one of the three properties of triangle similarity:<br>• Angle-Angle: two pairs of corresponding angles are equal<br>• Side-Side-Side: three pairs of corresponding sides are proportional<br>• Side-Angle-Side: two pairs of corresponding sides are proportional and the included angles are equal<br><br>Symbolic notation | | Determine the three pairs of equal angles and the three pairs of proportional sides, given the similarity.<br><br>Solve problems involving triangles. |

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| | | | | | | | can be used to represent similarity of triangles, including through<br>• a similarity statement, e.g.,<br>$\triangle ABC \sim \triangle RST$<br>$\triangle ABC \sim \triangle RST$<br>• corresponding sides, e.g.,<br>$AB \sim RS$<br>$\overline{BC} \sim \overline{ST}$<br>$BC \sim ST$<br>$\overline{AC} \sim \overline{RT}$ | | |

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| **Learning Outcome** | 7G1.2 Students analyze the structure and relationships of geometric objects. | | | 8G1.2 Students interpret similarity through scale factor. | | | | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | A point common to two or more geometric objects is called an intersection.<br><br>Angle relationships at the intersection of straight lines, line segments, or rays include<br>• opposite angles, which are congruent<br>• adjacent angles, which are supplementary<br><br>A transversal is a straight line, line segment, or ray that intersects two or more parallel lines.<br><br>Angle relationships at the intersections of a transversal and two or more parallel lines include congruent corresponding angles, which are in the same relative position at each point of intersection. | Relationships between geometric objects can be found at intersections. | Investigate angle relationships at the intersection of two straight lines.<br><br>Identify corresponding angles at intersections of parallel lines and a transversal.<br><br>Verify that two lines are parallel, using angles at intersections of a transversal.<br><br>Model angle relationships, using hands-on materials or a digital geometry environment.<br><br>Solve problems involving angle relationships at intersections. | Applying a dilation to a geometric object creates a similar shape.<br><br>A dilation is a transformation of size (non-rigid transformation) determined by a scale factor and a dilation centre.<br><br>A dilation centre is a fixed point on a plane, from which a geometric object is enlarged or reduced in all directions from the point.<br><br>The $x$- and $y$-coordinates of each vertex of a polygon can be multiplied by a scale factor to determine the dilated shape on the Cartesian plane, with a dilation centre at the origin.<br><br>A geometric object and its corresponding dilated shape can be connected by straight lines through the dilation centre. | Transformations of size can create similar shapes. | Dilate a geometric object in the Cartesian plane, given dilation centre $(0, 0)$ and a scale factor, using hands-on materials or a digital geometry environment.<br><br>Determine the coordinates of the vertices of a similar polygon, given dilation centre $(0, 0)$, a scale factor, and the coordinates of the polygon's vertices.<br><br>Verify that geometric objects are similar, using the Cartesian plane or straight lines. | | | |

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| **Learning Outcome** | 7G1.3 Students analyze the structure and relationships of geometric objects. | | | | | | | | |
| | In congruent polygons, corresponding<br>• vertices, sides, and angles are in the same relative position<br>• side measures are equal<br>• angle measures are equal<br><br>Congruence of geometric objects can be represented with symbols, including<br>• the same number of arcs on congruent angles<br>• the same number of hash marks on congruent line segments<br><br>Symbolic notation can be used to communicate congruence of geometric objects, including<br>• congruent angles, e.g., $\angle ABC \cong \angle RST$<br>• congruent sides, e.g., $\overline{AB} \cong \overline{RS}$<br>• congruent rectangles, e.g., $ABCD \cong RSTU$<br>• congruent triangles, e.g., $\triangle ABC \cong \triangle RST$ | Congruence of geometric objects can be verified through symbols and symbolic notation. | Identify corresponding sides and corresponding angles of congruent polygons.<br><br>Identify congruent angles and congruent line segments indicated with symbols in congruent polygons.<br><br>Verify that geometric objects are congruent, using symbolic notation.<br><br>Solve problems involving congruent polygons. | | | | | | |

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| **Organizing Idea** | Geometry: The properties of geometric objects are explained through justification and proof. | | | | | | | | |
| **Guiding Question** | | | | How might multiple geometric relationships influence interpretation of a geometric object? | | | | | |
| **Learning Outcome** | | | | 8G2 Students analyze and explain triangle problems, using theorems. | | | | | |
| | | | | Knowledge | Understanding | Skills & Procedures | | | |
| | | | | A theorem is a fact that is proved by previously known facts.<br><br>The interior angles in a triangle can be determined by using angle theorems, including<br>• the sum of all interior angles in a triangle is 180°<br>• the two angles opposite the two equal sides in an isosceles triangle are congruent<br>• all interior angles in an equilateral triangle are 60°<br><br>The triangle inequality theorem states that for any triangle, the sum of any two side lengths is greater than the length of the third side.<br><br>If $a$, $b$, and $c$ are the lengths of the sides of a triangle, the triangle inequality theorem can be represented as<br>$a + b > c$<br>$a + c > b$<br>$b + c > a$<br><br>The longest side of a right triangle, the hypotenuse, is directly opposite the right angle.<br><br>For any right triangle, the area of the square on the longest side, $c$, is equal to the sum of | Theorems are proved and can be applied to solve problems. | Justify unknown interior angle measures in triangles, using angle theorems.<br><br>Prove that a geometric object is a triangle, given the three side lengths.<br><br>Prove that a triangle is a right triangle, using hands-on materials or a digital geometry environment.<br><br>Determine an unknown side length in a right triangle, given any two side lengths, using the Pythagorean theorem.<br><br>Illustrate a problem involving triangles, using hands-on materials or a digital geometry environment.<br><br>Solve problems involving triangles, using theorems. | | | |

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| | | | | the areas of the squares on the two shorter sides, *a and b*, according to the Pythagorean theorem.<br><br>The Pythagorean theorem can be represented symbolically as $a^2 + b^2 = c^2$ | | | | | |

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| **Organizing Idea** | Measurement: Attributes such as length, area, volume, and angle are quantified by measurement. | | | | | | | | |
| **Guiding Question** | In what ways can measurable attributes of circles influence perspectives of size? | | | | | | | | |
| **Learning Outcome** | 7M1 Students interpret and explain area and circumference of circles. | | | | | | | | |
| | A circle is a 2-D shape structured by a set of points that are all the same distance from one point, known as the centre.<br><br>The perimeter of a circle is called circumference.<br><br>The radius of a circle is the distance from the centre to any point on the circle.<br><br>The diameter is the distance across a circle, through the centre, and is twice the length of the radius.<br><br>Area and circumference are different interpretations of the size of a circle.<br><br>There is a constant ratio $\pi$ (pi) that relates the circumference of any circle and its diameter.<br><br>The circumference of a circle can be expressed as the product of its diameter and $\pi$, represented symbolically as<br>$C = \pi D$<br><br>The area of a circle can be divided into equal sized pie-shaped slices (sectors) and rearranged to form an approximation of a | The size of a circle is determined by its radius. | Create circles, given the radius, using a compass or a digital geometry environment.<br><br>Investigate the relationship between the circumference of a circle and its diameter.<br><br>Determine the diameter of a circle, given its circumference and using 3.14 as an approximation for $\pi$.<br><br>Derive the symbolic notation to calculate the area of a circle from the area of a parallelogram.<br><br>Calculate the area and circumference of a circle, given its radius or diameter and using 3.14 as an approximation for $\pi$.<br><br>Solve problems involving circumference and area of circles. | | | | | | |

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| | parallelogram.<br><br>The area of a circle can be expressed as the product of the square of its radius and $\pi$, represented symbolically as $A = \pi r^2$ | | | | | | | | |

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| **Organizing Idea** | Measurement: Attributes such as length, area, volume, and angle are quantified by measurement. | | | | | | | | |
| **Guiding Question** | In what ways can area provide perspectives of volume? | | | In what ways can a 3-D shape be modelled to support its measurement? | | | In what ways can the decomposition of a 3-D shape support its measurement? | | |
| **Learning Outcome** | 7M2 Students analyze volume of right prisms and right cylinders. | | | 8M2 Students analyze the surface area of right 3-D shapes, using 2-D models. | | | 9M2.1 Students analyze surface area and volume of right composite 3-D shapes. | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | A prism is a solid 3-D shape with rectangular lateral faces and two parallel congruent polygonal bases.<br><br>The base of a prism can be any polygon, including rectangles and triangles.<br><br>A prism is named according to the shape of its base.<br><br>Any face of a rectangular prism can be interpreted as the base.<br><br>A cylinder is a solid 3-D shape with one curved lateral surface and parallel congruent circular bases.<br><br>Dimensions of a rectangular prism are its length, width, and height.<br><br>Dimensions of a cylinder are its radius and height.<br><br>Dimensions can be used for calculating the volume of a 3-D shape.<br><br>The dimensions of a 3-D shape must be measured in the same units to calculate volume.<br><br>The volume of a prism can be represented as | The volume of a prism or cylinder can be explained as a product of dimensions. | Relate the name of a prism to the shape of its base.<br><br>Differentiate the lateral faces and lateral surfaces from the bases of prisms and cylinders oriented in various ways.<br><br>Model volume of rectangular prisms by iterating the volume of a single layer, using hands-on materials or a digital geometry environment.<br><br>Calculate the volume of rectangular prisms, triangular prisms, and cylinders.<br><br>Determine the area of the base of rectangular prisms, triangular prisms, and cylinders, given volume and height.<br><br>Determine the height of rectangular prisms, triangular prisms, and cylinders, given volume and area of the base.<br><br>Solve problems involving volume of prisms and cylinders. | Polyhedrons, including prisms and pyramids, are 3-D shapes with polygonal faces.<br><br>Certain 3-D shapes are not polyhedrons, such as cylinders and spheres.<br><br>A pyramid is a polyhedron with triangular lateral faces and one polygonal base opposite a vertex called the apex.<br><br>The surface of a 3-D shape is a composition of faces and curved surfaces that are various 2-D shapes.<br><br>Each 2-D shape that composes the surface of a 3-D shape has dimensions that are necessary for calculating its area, including<br>• base<br>• height<br>• radius<br><br>Surface area of a 3-D shape is the sum of the areas of its surface.<br><br>The curved lateral surface of a cylinder is a rectangle, where the length is equal to the circumference of the circular base.<br><br>A 2-D model may not represent all of the faces and curved | Representing 3-D shapes with 2-D models can facilitate calculation of surface area. | Identify if a 3-D shape is a polyhedron.<br><br>Calculate the surface area of various polyhedrons and cylinders, using a 2-D model.<br><br>Solve problems involving surface area of polyhedrons and cylinders.<br><br>Predict the 3-D shape modelled by a net.<br><br>Relate each shape on a net to the corresponding face of a 3-D shape.<br><br>Differentiate between examples and non-examples of nets for a cube.<br><br>Justify the choice of net, orthographic drawing, or isometric drawing to represent a 3-D shape.<br><br>Recognize the orthographic drawing and isometric drawing related to a given 3-D shape, and vice versa.<br><br>Create orthographic drawings for 3-D shapes, with or without a digital geometry environment.<br><br>Model 3-D shapes related to given | Surface area of a composite 3-D shape<br>• is often less than the sum of the surface areas of each individual 3-D shape from which it is composed<br>• does not necessarily decrease when a portion of the shape is removed<br><br>The volume of a composite 3-D shape is equal to the sum or difference of the volumes of the individual 3-D shapes.<br><br>The height of a pyramid is the perpendicular distance from its base to its apex.<br><br>The volume of a pyramid is one third the volume of any prism with a congruent base and equal height. | A composite 3-D shape can be perceived as a composition of multiple 3-D shapes to facilitate measurement. | Visualize and model the 2-D shapes that compose the surface of a composite 3-D shape, using 2-D models or a digital geometry environment.<br><br>Compare the surface area of a composite 3-D shape to the sum of the surface areas of the 3-D shapes from which it is composed.<br><br>Describe the effect of adding or removing one or more 3-D shapes on the surface area of a composite 3-D shape.<br><br>Calculate the surface area of composite 3-D shapes composed of prisms, pyramids, and cylinders.<br><br>Visualize and model a composite 3-D shape as a composition of multiple 3-D shapes, using 3-D models or a digital geometry environment.<br><br>Describe the effect of adding or removing one or more 3-D shapes on the volume of a composite 3-D shape.<br><br>Visualize the decomposition of a rectangular prism into rectangular pyramids, using 3-D models or a |

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| | the volume of a single layer of 1 × 1 × 1 cubes multiplied by the total number of layers.<br><br>The volume of any prism or cylinder can be generalized as the product of the area of the base and the perpendicular height of the prism or cylinder, represented symbolically as<br>$V = Bh$ | | | surfaces of a 3-D shape.<br><br>2-D models of 3-D shapes include<br>• nets<br>• orthographic drawings<br>• isometric drawings<br><br>A net is a 2-D model of the surface of a 3-D shape that can be folded into a 3-D model.<br><br>A 3-D shape can have different nets.<br><br>An orthographic drawing shows the front, top, and right-side views of a 3-D shape separately.<br><br>An isometric drawing shows a 3-D shape rotated to show the front, top, and right-side views. | | orthographic drawings and isometric drawings. | | | |

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| | | | | | | | 9M2.2 Students analyze surface area and volume of right composite 3-D shapes. | | |
| | | | | | | | Among all rectangular prisms with the same volume, the cube has the smallest surface area.<br><br>Measures of surface area and volume support decision making in many real-world situations, such as<br>• painting walls<br>• designing packages<br>• packing containers | Relationships between surface area and volume can support problem solving in real-world situations. | Compare the surface areas of various rectangular prisms that have equal volumes, using cube structures or 2-D models.<br><br>Investigate the effect of decreasing the height and increasing the dimensions of the base on the volume of prisms, pyramids, and cylinders.<br><br>Solve problems involving surface area and volume in real-world situations. |

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| **Organizing Idea** | Functions: Functions model relationships between changing quantities in real-world situations. | | | | | | | | |
| **Guiding Question** | In what ways can functions be characterized? | | | How can functions contextualize change? | | | In what ways can real-world situations be modelled? | | |
| **Learning Outcome** | 7F1 Students interpret functions through domain and range. | | | 8F1 Students relate linear functions to equations and graphs. | | | 9F1 Students connect linear functions to real-world situations. | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | The independent and dependent variables, respectively, represent the input and output values of a function.<br><br>A relation is any correspondence between two changing quantities represented by input values and output values.<br><br>A function is a relation where each input value corresponds to exactly one output value.<br><br>The domain of a function is the set of all possible input values and can be communicated in words.<br><br>The range of a function is the set of all possible output values and can be communicated in words.<br><br>A function can be discrete or continuous. | Domain and range are attributes of a function. | Distinguish between discrete and continuous functions.<br><br>Describe the domain and range of a function.<br><br>Describe restrictions on the domain and range of a function that models a real-world situation.<br><br>Graph a function that models a real-world situation, given a table of values.<br><br>Determine whether a relation is a function. | Slope is the steepness of a line and has both magnitude and direction.<br><br>The steeper the slope of a line, the greater its magnitude.<br><br>A horizontal line has a slope of zero.<br><br>A vertical line has an undefined slope.<br><br>A line that slants in an upward direction from left to right indicates a positive slope.<br><br>A line that slants in a downward direction from left to right indicates a negative slope.<br><br>Slope, $m$, of a line can be described by the ratio of the rise (vertical displacement) to the run (horizontal displacement) between two points on the line, | Attributes of linear functions support connections between graphs and equations. | Calculate the slope of a line, given two points on the line.<br><br>Compare the slopes of various parallel lines.<br><br>Compare the slopes of various perpendicular lines.<br><br>Investigate how $b$ and $m$ in the equation $y = mx + b$ affect the vertical position and steepness of a graph.<br><br>Prove that the slope of a vertical line is undefined.<br><br>Distinguish between graphs of linear and non-linear functions.<br><br>Investigate how variations of slope and $y$-intercepts contextually affect the rate of change of a linear function.<br><br>Propose a possible real-world situation, | Function notation can be used to represent<br>• a function symbolically, e.g., $f(x) = 2x + 3$<br>• the output value for a given input value, e.g., if the input value $x = 3, f(3) = 9$<br><br>Function notation includes<br>• a letter to name the function, followed by the input value in parentheses, e.g., $f(x)$<br>• the input value, e.g., $x$<br>• the output value, e.g., $f(x)$<br>• the function rule, e.g., $2x + 3$<br><br>Intercepts of the graph of a function have meaning within the context of real-world situations, e.g.,<br>• amount of money in a bank account before monthly deposits | Mathematical notation provides a structured way to define and analyze functions. | Express a linear function in function notation, given two points from the graph.<br><br>Express a linear function in function notation, given the slope and one point from the graph.<br><br>Interpret the meaning of $x$- and $y$-intercepts of linear functions within the context of real-world situations.<br><br>Express the domain and range of a linear function, using set-builder notation.<br><br>Relate various representations of a linear function.<br><br>Evaluate a function in function notation, given an input value.<br><br>Determine the input value, given the output |

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| | Domain and range can be discrete or continuous, and the maximum and minimum values can be restricted to model a real-world situation.<br><br>Domain and range can be interpreted from various representations of a function, including<br>• ordered pairs<br>• a table of values<br>• a graph<br>• a real-world situation<br><br>The graph of a discrete function is the set of points described by ordered pairs.<br><br>The graph of a continuous function is a line that connects all points described by ordered pairs.<br><br>The graph of a function will be intersected at no more than one point by a vertical line drawn on the Cartesian plane, known as the vertical line test. | | | e.g., between points $P(x_1, y_1)$ and $Q(x_2, y_2)$, slope is represented symbolically as<br>$m = \frac{y_2 - y_1}{x_2 - x_1}$<br>A linear function can be represented by a non-vertical straight line or a set of points that follow a non-vertical linear path.<br><br>Slope provides insight into the rate of change modelled by a linear function.<br><br>Rate of change describes the change in one variable with respect to another variable in a situation modelled by a function, such as<br>• constant speed<br>• hourly wages<br>• filling a container at a constant rate<br><br>Linear functions have a constant rate of change.<br><br>Rate of change of a linear function can be determined from any representation of the function by using the slope formula.<br><br>A linear function can be expressed as an equation in slope-intercept form, represented symbolically as $y = mx + b$, where $m$ is the slope and $b$ is the constant and the $y$-intercept.<br><br>The graph of a horizontal line can be expressed as an equation, represented symbolically as $y = b$. | | with a restricted domain and range, related to a given slope.<br><br>Graph a linear function, given slope and one point on the line.<br><br>Solve problems involving rate of change from various representations modelling real-world situations.<br><br>Prove that a linear function has exactly one $x$-intercept.<br><br>Express, as an ordered pair, the $x$- and $y$-intercepts of a linear function from a graph or equation.<br><br>Express a linear function as an equation in slope-intercept form, given the graph.<br><br>Graph a linear function, given the equation.<br><br>Express a horizontal or vertical line as an equation.<br><br>Graph horizontal and vertical lines. | ($y$-intercept)<br>• amount of time it takes to empty a tank of gas ($x$-intercept)<br><br>Domain and range can be represented by using set-builder notation or statements, e.g.,<br>• D: $\{x \mid x \leq 1, x \in \mathbb{Z}\}$ or Domain is the set of all integers, $x$, such that $x$ is less than or equal to $1$.<br>• R: $\{y \mid y \in \mathbb{R}\}$ or Range is the set of all numbers, $y$, such that $y$ is an element of the real numbers.<br><br>Domain and range may be restricted to model real-world situations.<br><br>Arithmetic sequences can be generated by restricting the domain to natural numbers greater than zero.<br><br>Interpolation can be used to predict a value between points on the graph of a function.<br><br>Extrapolation can be used to predict a value beyond points on the graph of a function. | | value of the function in function notation.<br><br>Generate an arithmetic sequence, given a function.<br><br>Predict input and output values of a linear function, using interpolation and extrapolation.<br><br>Solve problems involving linear functions. |

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| | | | | The graph of a vertical line can be expressed as an equation, represented symbolically as $x = a$, where $a$ is a constant.<br><br>The $x$-intercept of a function, indicated by the point at which a graph crosses the $x$-axis, is the value of the $x$-coordinate when the $y$-coordinate is zero.<br><br>A linear function where $m$ 偃= 0 has exactly one $x$-intercept, which is the solution of the equation $mx + b = 0$.<br><br>The $y$-intercept of a function, indicated by the point at which a graph crosses the $y$-axis, is the value of the $y$-coordinate when the $x$-coordinate is zero.<br><br>A linear function has exactly one $y$-intercept. | | | | | |

| | Grade 7 | | | Grade 8 | | | Grade 9 | | |
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| **Organizing Idea** | Statistics: The science of collecting, analyzing, visualizing, and interpreting data can inform understanding and decision making. | | | | | | | | |
| **Guiding Question** | How can statistics support generalizations? | | | In what ways can representation clarify a distribution? | | | In what ways can statistics clarify a distribution? | | |
| **Learning Outcome** | 7ST1.1 Students interpret sample data. | | | 8ST1.1 Students analyze distributions, using shape. | | | 9ST1 Students analyze distributions, using spread. | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | A population is a complete set of elements, such as people, animals, objects, or events, that are the focus of a statistical question.<br><br>A population is defined by one or more shared characteristics, such as age, location, time, or type.<br><br>A census is the collection of data from an entire population.<br><br>A sample is a subset of a population.<br><br>A sample can be used in place of a population when a census would be<br>• too costly<br>• too time-consuming<br>• too difficult<br><br>A representative sample has the same defining characteristics as the population.<br><br>A representative sample can be obtained by using random sampling methods, including<br>• simple random sampling<br>• systematic random sampling | Samples can represent populations. | Identify the population for a statistical question.<br><br>Justify the use of data from a sample or a census in various situations.<br><br>Describe a representative sample for a population in relation to a statistical question.<br><br>Explain the process for obtaining a representative sample by using a chosen random sampling method. | A distribution is an ordered data set in which the frequencies of all data values are evident.<br><br>A bar graph is a graphical representation of discrete data that shows the shape of a distribution by using the frequency of data grouped in categories.<br><br>A histogram is a graphical representation of continuous data that shows the shape of a distribution by using the frequency of data grouped in intervals.<br><br>One graph, e.g., a double bar graph, can be used to compare multiple sets of discrete data.<br><br>The shape of a distribution is described by the number of modes it has and whether it is symmetric, uniform, or skewed.<br><br>In a symmetrical distribution of quantitative data, the mean and the median are equal.<br><br>In a left-skewed distribution of quantitative data, the mean is less than the median and mode. | Shape can determine which statistic best typifies a data set. | Describe the shape of distributions.<br><br>Explain the effects of changing the size of the intervals in a histogram on the interpretation of the shape of a distribution.<br><br>Represent distributions, using histograms with equal intervals.<br><br>Compare the shape of distributions from two different samples of the same population.<br><br>Justify the choice of mean, median, or mode to typify a data set for distributions of various shapes. | The spread of a distribution describes how close data values are to each other.<br><br>The spread of a distribution can be described by range.<br><br>Benchmarks that divide a distribution into four groups, each containing the same number of data values, are called a five-number summary:<br>• minimum value<br>• lower quartile, $Q_1$: the median of the lower half of the data set<br>• median: the median of the whole data set<br>• upper quartile, $Q_3$: the median of the upper half of the data set<br>• maximum value<br><br>The interquartile range describes the spread of the middle 50% of a distribution and can be represented symbolically as<br>$IQR = Q_3 - Q_1$<br><br>A box plot is a graphical representation that shows the spread of a distribution by using the groups of data defined by the five- | Spread can affect how well a statistic typifies a data set. | Determine the range, five-number summary, and interquartile range for a distribution.<br><br>Identify outliers in a distribution.<br><br>Examine the effect of outliers on measures of central tendency and spread.<br><br>Justify the inclusion or exclusion of an outlier from a data set.<br><br>Represent distributions, using box plots.<br><br>Interpret the spread of distributions represented by box plots.<br><br>Compare the spread of distributions of two different samples of the same population, using box plots. |

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| | | | | In a right-skewed distribution of quantitative data, the mean is greater than the median and mode.<br><br>The peaks of bar graphs and histograms represent the modes of a distribution, including unimodal and bimodal distributions.<br><br>Measures of central tendency, including mean, median, and mode, are statistics that describe the centre of a distribution.<br><br>Measures of central tendency can describe typical data values for a data set. | | | number summary.<br><br>Outliers can be the result of various factors, such as<br>• sampling errors<br>• measurement errors<br>• natural differences in a population<br><br>Outliers can affect the spread of a distribution.<br><br>In a box plot, outliers are indicated as data points outside of the distribution.<br><br>An outlier is a data value that has a distance below the lower quartile or above the upper quartile of more than 1.5 times the interquartile range. | | |

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| **Learning Outcome** | 7ST1.2 Students interpret sample data. | | | 8ST1.2 Students analyze distributions, using shape. | | | | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | | |
| | Quantitative data are numerical data that can be discrete or continuous.<br><br>Discrete data are countable, specific values within a range, between which other values cannot exist.<br><br>Continuous data are measurable values within a range, between which infinitely many other values can exist.<br><br>Numbers used to describe a sample are called statistics, including | Data collected from a sample can be summarized by using statistics. | Determine mean, median, mode, and range for a set of quantitative data collected from a representative sample.<br><br>Compare statistics from two different samples of the same population.<br><br>Draw conclusions about a population, using statistics from a representative sample. | A circle graph is a graphical representation of categorical data that shows the distribution through proportional sections in a circle.<br><br>In a circle graph, the number of data points in each category corresponds to a proportional section of 360 degrees.<br><br>A circle graph can use percentages to indicate the number of data points in each section. | Circle graphs communicate categorical data efficiently. | Represent data, using a circle graph.<br><br>Analyze circle graphs to solve problems. | | | |

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| | • mean<br>• median<br>• mode<br>• range<br><br>The mean describes the centre of a data set by using the sum of the data values divided by the number of data values, e.g.,<br><br>$\bar{x} = \frac{x_1 + x_2 + ...xn}{n}$<br><br>The median is the middle value, or the mean of the two middle values, in a set of data ordered numerically.<br><br>The range is the difference between the maximum and minimum values of a data set. | | | | | | | | |

| | **Grade 7** | | | **Grade 8** | | | **Grade 9** | | |
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| **Organizing Idea** | Probability: Modelling randomness and quantifying the likelihood of events can inform decision making where uncertainty exists. | | | | | | | | |
| **Guiding Question** | In what ways can likelihood be explained? | | | In what ways can multiple events affect probability? | | | How can outcomes relate to more than one event? | | |
| **Learning Outcome** | 7PR1.1 Students interpret theoretical and experimental probability. | | | 8PR1 Students interpret probability of independent and dependent events. | | | 9PR1 Students interpret probability of mutually exclusive and non-mutually exclusive events. | | |
| | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures | Knowledge | Understanding | Skills & Procedures |
| | A set is a collection of objects of any nature.<br><br>An outcome is any possible result of an experiment.<br><br>An event is a set of outcomes, and any outcome that matches the event is called a favourable outcome.<br><br>A simple event is when only one event can occur.<br><br>The probability of an event numerically represents its likelihood.<br><br>Events that are certain have a probability of 1.<br><br>Events that are impossible have a probability of 0.<br><br>Equally likely outcomes have the same probability.<br><br>Not all events have an equal likelihood, e.g., a biased coin. | Probability quantifies the likelihood that an event occurs. | Describe favourable outcomes for a given event.<br><br>Describe one outcome as more or less likely than another outcome.<br><br>Describe situations where not all events are equally likely.<br><br>Explain certain and impossible events. | Sample space can be represented in various ways, including<br>• set notation<br>• lists<br>• tables<br><br>Set notation can represent a sample space, $S$, as an ordered or unordered list of all possible outcomes inside braces, e.g., $S = \{H, T\}$ represents the sample space for flipping a coin.<br><br>A compound event can consist of two or more events.<br><br>The sample space of compound events can be represented with various models, including<br>• tree diagrams<br>• area models<br>• set notation<br><br>Two events are independent if the occurrence of one event does not affect the occurrence of the other.<br><br>Two events are dependent if the occurrence of one event affects the occurrence of the other. | The occurrence of one event can affect the probability of another. | Determine whether two events are independent or dependent.<br><br>Determine the probability of two or more independent events by modelling the sample space.<br><br>Determine the probability of two dependent events by modelling the sample space. | Operations on events correspond to set operations.<br><br>Two events, $A$ and $B$, may be combined into new events through unions and intersections.<br><br>The union of sets that corresponds to $A$ or $B$ is denoted as $A \cup B$.<br><br>The intersection of sets that corresponds to $A$ and $B$ is denoted as $A \cap B$.<br><br>The intersection of events $A$ and $B$ consists of outcomes common to both events.<br><br>The union of two events, $A$ or $B$, is equal to the set of outcomes that are present in set $A$, set $B$, or both.<br><br>The probability of independent events is the product of the individual probabilities, denoted as $P(A \cap B) = P(A) \times P(B)$<br><br>Two events that cannot occur together as one outcome are called mutually exclusive.<br><br>The probability of | One outcome can define multiple events. | Calculate the probability of the intersection of two independent events.<br><br>Determine whether two events are mutually exclusive.<br><br>Model sample spaces and events with Venn diagrams.<br><br>Calculate the probability of the union of two non-mutually exclusive events.<br><br>Calculate the probability of the union of two mutually exclusive events.<br><br>Identify complementary events.<br><br>Calculate the probability of an event, given the probability of its complement, and vice versa. |

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| **Learning Outcome** | 7PR1.2 Students interpret theoretical and experimental probability. | | | | |
| | Theoretical probability is the likelihood of an event occurring under ideal conditions.<br><br>If all outcomes are equally likely, the theoretical probability is the ratio of the number of favourable outcomes to the total number of outcomes.<br><br>Experimental probability is determined by using data collected from repeated trials of an experiment.<br><br>Experimental probability compares the number of favourable outcomes to the total number of trials of an experiment.<br><br>Sample space is the list of all possible outcomes for a situation or an experiment and does not include the frequency of each outcome.<br><br>The sum of the probabilities within a sample space is 1.<br><br>A situation can be simulated if it has the same number of possible outcomes and each outcome occurs with the same probability, e.g., within a sample space, a coin has two equally likely outcomes and a die has six. | Over a large number of trials, experimental probability models theoretical probability. | Express, in various ways, the theoretical probability for each of the possible outcomes in a situation.<br><br>Predict the experimental probability of an event, using theoretical probability.<br><br>Collect data from multiple trials of an experiment with equally likely outcomes.<br><br>Simulate situations by generating a sample space.<br><br>Determine the experimental probability of an event.<br><br>Compare the experimental probability to the theoretical probability for a given event.<br><br>Relate probability to decision making in various situations. | | |

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| | Probability can be expressed in various ways, including<br>• ratio<br>• fraction<br>• decimal<br>• percentage<br><br>In an experiment, the outcome of any trial is unknown before it occurs, except for certain and impossible events.<br><br>Repeated trials of an experiment have no influence on each other.<br><br>• Probability can inform decision making in various situations, such as games and weather forecasts. | | | | | | | | |

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