ExploreLearning Gizmos®

Correlations for Utah Core Standards for Math

ExploreLearning®

Third Grade

3.MP: Mathematical Practices

Students become mathematically proficient in engaging with mathematical content and concepts as they learn, experience, and apply these skills and attitudes

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

Biconditional Statements
Conditional Statements
Estimating Population Size
Pattern Flip (Patterns)

3.MP.1.a: Explain the meaning of a problem, look for entry points to begin work on the problem, and plan and choose a solution pathway. When a solution pathway does not make sense, look for another pathway that does. Explain connections between various solution strategies and representations. Upon finding a solution, look back at the problem to determine whether the solution is reasonable and accurate, often checking answers to problems using a different method or approach.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Expressions

3.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

3.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

3.MP.3.a: Use stated assumptions, definitions, and previously established results to construct arguments. Explain and justify the mathematical reasoning underlying a strategy, solution, or conjecture by using concrete referents such as objects, drawings, diagrams, and actions. Listen to or read the arguments of others, decide whether they make sense, ask useful questions to clarify or improve the arguments, and build on those arguments.

Biconditional Statements
Conditional Statements

3.MP.4: Model with mathematics.

Estimating Sums and Differences

3.MP.5: Use appropriate tools strategically.

Elapsed Time

3.MP.5.a: Consider the tools that are available when solving a mathematical problem, whether in a real-world or mathematical context. Choose tools that are relevant and useful to the problem at hand, such as drawings, diagrams, technologies, and physical objects and tools, as well as mathematical tools such as estimation or a particular strategy or algorithm.

Segment and Angle Bisectors

3.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

3.MP.6.a: Communicate precisely to others by crafting careful explanations that communicate mathematical reasoning by referring specifically to each important mathematical element, describing the relationships among them, and connecting their words clearly to representations. Calculate accurately and efficiently, and use clear and concise notation to record work.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

3.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

3.MP.7.a: Recognize and apply the structures of mathematics such as patterns, place value, the properties of operations, or the flexibility of numbers. See complicated things as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

3.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

3.MP.8.a: Notice repetitions in mathematics when solving multiple related problems. Use observations and reasoning to find shortcuts or generalizations. Evaluate the reasonableness of intermediate results.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

3.OA: Operations and Algebraic Thinking

Represent and solve problems involving multiplication and division within 100.

3.OA.1: Interpret products of whole numbers, such as interpret 5 × 7 as the total number of objects in 5 groups of 7 objects each.

Chocomatic (Multiplication, Arrays, and Area)
Critter Count (Modeling Multiplication)

3.OA.2: Interpret whole-number quotients of whole numbers.

No Alien Left Behind (Division with Remainders)

3.OA.3: Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities.

Chocomatic (Multiplication, Arrays, and Area)
Critter Count (Modeling Multiplication)
No Alien Left Behind (Division with Remainders)

3.OA.4: Determine the unknown whole number in a multiplication or division equation relating three whole numbers.

Factor Trees (Factoring Numbers)

They demonstrate understanding of the properties of multiplication and the relationship between multiplication and division.

3.OA.6: Understand division as an unknown-factor problem. Understand the relationship between multiplication and division (multiplication and division are inverse operations).

Factor Trees (Factoring Numbers)

Represent and solve problems involving multiplication and division within 100.

3.OA.7: Fluently multiply and divide.

3.OA.7.a: Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division or properties of operations. (For example, knowing that 8 x 5 = 40, one knows 40 ÷ 5 = 8).

Critter Count (Modeling Multiplication)
Factor Trees (Factoring Numbers)
Multiplying Decimals (Area Model)
No Alien Left Behind (Division with Remainders)
Pattern Flip (Patterns)

3.OA.7.b: By the end of Grade 3, know from memory all products of two one-digit numbers.

Critter Count (Modeling Multiplication)
Factor Trees (Factoring Numbers)
Multiplying Decimals (Area Model)
Pattern Flip (Patterns)

Students use the four operations to identify and explain patterns in arithmetic.

3.OA.8: Solve two-step word problems.

3.OA.8.a: Solve two-step word problems using the four operations. Know how to perform operations in the conventional order when there are no parentheses to specify a particular order (Order of Operations). (Limit to problems posed with whole numbers and having whole number answers.)

Cargo Captain (Multi-digit Subtraction)
Critter Count (Modeling Multiplication)
No Alien Left Behind (Division with Remainders)
Number Line Frog Hop (Addition and Subtraction)
Using Algebraic Equations
Using Algebraic Expressions

3.OA.8.b: Represent two-step problems using equations with a letter standing for the unknown quantity. Create accurate equations to match word problems.

Cargo Captain (Multi-digit Subtraction)
Critter Count (Modeling Multiplication)
No Alien Left Behind (Division with Remainders)
Number Line Frog Hop (Addition and Subtraction)
Using Algebraic Equations
Using Algebraic Expressions

3.OA.8.c: Assess the reasonableness of answers using mental computation and estimation strategies, including rounding.

Cargo Captain (Multi-digit Subtraction)
Critter Count (Modeling Multiplication)
No Alien Left Behind (Division with Remainders)
Number Line Frog Hop (Addition and Subtraction)
Using Algebraic Equations
Using Algebraic Expressions

3.OA.9: Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations.

Pattern Flip (Patterns)

3.NBT: Number and Operations in Base Ten

Use place value understanding and properties of operations to perform multi-digit arithmetic. A range of algorithms may be used.

3.NBT.1: Use place value understanding to round whole numbers to the nearest 10 or 100.

Rounding Whole Numbers (Number Line)

3.NBT.2: Fluently add and subtract within 1,000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

Adding Fractions (Fraction Tiles)
Adding Whole Numbers and Decimals (Base-10 Blocks)
Cargo Captain (Multi-digit Subtraction)
Fractions Greater than One (Fraction Tiles)
Number Line Frog Hop (Addition and Subtraction)
Rounding Whole Numbers (Number Line)
Subtracting Whole Numbers and Decimals (Base-10 Blocks)
Target Sum Card Game (Multi-digit Addition)
Whole Numbers with Base-10 Blocks

3.NF: Number and Operations—Fractions

Develop understanding of fractions as numbers.

3.NF.1: Understand that a unit fraction has a numerator of one and a non-zero denominator.

3.NF.1.a: Understand a fraction 1/b as the quantity formed by one part when a whole is partitioned into b equal parts.

Equivalent Fractions (Fraction Tiles)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Fraction Garden (Comparing Fractions)
Fraction, Decimal, Percent (Area and Grid Models)
Modeling Fractions (Area Models)
Toy Factory (Set Models of Fractions)

3.NF.1.b: Understand a fraction a/b as the quantity formed by a parts of size 1/b. For example: 1/4 + 1/4 + 1/4 = 3/4.

Equivalent Fractions (Fraction Tiles)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Fraction Garden (Comparing Fractions)
Fraction, Decimal, Percent (Area and Grid Models)
Modeling Fractions (Area Models)
Toy Factory (Set Models of Fractions)

3.NF.2: Understand a fraction as a number on the number line; represent fractions on a number line diagram.

3.NF.2.a: Represent a fraction 1/b on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into b equal parts. Recognize that each part has size 1/b and that the endpoint of the part based at 0 locates the number 1/b on the number line.

Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Modeling Fractions (Area Models)

3.NF.2.b: Represent a fraction a/b on a number line diagram by marking off a lengths 1/b from 0. Recognize that the resulting interval has size a/b and that its endpoint locates the number a/b on the number line.

Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Modeling Fractions (Area Models)

3.NF.3: Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size.

3.NF.3.a: Understand two fractions as equivalent if they are the same size, or the same point on a number line.

Adding Fractions (Fraction Tiles)
Equivalent Fractions (Fraction Tiles)
Factor Trees (Factoring Numbers)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Modeling Fractions (Area Models)
Toy Factory (Set Models of Fractions)

3.NF.3.b: Recognize and generate simple equivalent fractions, such as 1/2 = 2/4, 4/6 = 2/3. Explain why the fractions are equivalent by using a visual fraction model, for example.

Adding Fractions (Fraction Tiles)
Equivalent Fractions (Fraction Tiles)
Factor Trees (Factoring Numbers)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Modeling Fractions (Area Models)
Toy Factory (Set Models of Fractions)

3.NF.3.c: Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers.

Equivalent Fractions (Fraction Tiles)

3.NF.3.d: Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, for example, by using a visual fraction model.

Adding Fractions (Fraction Tiles)
Equivalent Fractions (Fraction Tiles)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Modeling Fractions (Area Models)
Toy Factory (Set Models of Fractions)

3.MD: Measurement and Data

Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.

3.MD.1: Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, for example, by representing the problem on a number line diagram.

Elapsed Time

3.MD.2: Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), milliliters (ml), and liters (l). (Excludes compound units such as cubic centimeters [cc or cm3] and finding the geometric volume of a container.) Add, subtract, multiply, or divide to solve one-step word problems involving masses of objects or volumes of liquids that are given in the same units, for example, by using drawings (such as a beaker with a measurement scale) to represent the problem. (Excludes multiplicative comparison problems.)

Balancing Blocks (Volume)
Cannonball Clowns (Number Line Estimation)

Represent and interpret data.

3.MD.3: Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.

Forest Ecosystem
Graphing Skills
Mascot Election (Pictographs and Bar Graphs)
Reaction Time 1 (Graphs and Statistics)

3.MD.4: Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot where the horizontal scale is marked off in appropriate units-whole numbers, halves, or quarters.

Reaction Time 2 (Graphs and Statistics)

Understand concepts of area and relate area to multiplication and addition.

3.MD.5: Recognize area as an attribute of plane figures and understand concepts of area measurement.

3.MD.5.a: A square with side length one unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.

Balancing Blocks (Volume)
Chocomatic (Multiplication, Arrays, and Area)
Fido's Flower Bed (Perimeter and Area)

3.MD.5.b: A plane figure which can be covered without gaps or overlaps by n unit squares is said to have an area of n square units.

Balancing Blocks (Volume)
Chocomatic (Multiplication, Arrays, and Area)
Fido's Flower Bed (Perimeter and Area)

3.MD.6: Measure area by counting unit squares (square centimeters, square meters, square inches, square feet, and improvised units).

Balancing Blocks (Volume)
Chocomatic (Multiplication, Arrays, and Area)
Fido's Flower Bed (Perimeter and Area)

3.MD.7: Relate area to the operations of multiplication and addition (refer to 3.OA.5).

3.MD.7.a: Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.

Chocomatic (Multiplication, Arrays, and Area)
Fido's Flower Bed (Perimeter and Area)

3.MD.7.b: Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real-world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning.

Chocomatic (Multiplication, Arrays, and Area)
Fido's Flower Bed (Perimeter and Area)

3.MD.7.c: Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and b + c is the sum of a x b and a x c. Use area models to represent the distributive property in mathematical reasoning.

Balancing Blocks (Volume)
Chocomatic (Multiplication, Arrays, and Area)
Fido's Flower Bed (Perimeter and Area)

3.MD.7.d: Recognize area as additive. Find areas of rectilinear figures by decomposing them into non- overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real-world problems.

Chocomatic (Multiplication, Arrays, and Area)

Recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

3.MD.8: Solve real-world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Fido's Flower Bed (Perimeter and Area)

3.G: Geometry

Reason with shapes and their attributes.

3.G.1: Understand that shapes in different categories (for example, rhombuses, rectangles, and others) may share attributes (for example, having four sides), and that the shared attributes can define a larger category (for example, quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.

Classifying Quadrilaterals

3.G.2: Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole.

Fraction Artist 1 (Area Models of Fractions)

Fourth Grade

4.MP: Mathematical Practices

Students become mathematically proficient in engaging with mathematical content and concepts as they learn, experience, and apply these skills and attitudes

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

Biconditional Statements
Conditional Statements
Estimating Population Size
Pattern Flip (Patterns)

4.MP.1.a: Explain the meaning of a problem, look for entry points to begin work on the problem, and plan and choose a solution pathway. When a solution pathway does not make sense, look for another pathway that does. Explain connections between various solution strategies and representations. Upon finding a solution, look back at the problem to determine whether the solution is reasonable and accurate, often checking answers to problems using a different method or approach.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Expressions

4.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

4.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

4.MP.3.a: Use stated assumptions, definitions, and previously established results to construct arguments. Explain and justify the mathematical reasoning underlying a strategy, solution, or conjecture by using concrete referents such as objects, drawings, diagrams, and actions. Listen to or read the arguments of others, decide whether they make sense, ask useful questions to clarify or improve the arguments, and build on those arguments.

Biconditional Statements
Conditional Statements

4.MP.4: Model with mathematics.

Estimating Sums and Differences

4.MP.5: Use appropriate tools strategically.

Elapsed Time

4.MP.5.a: Consider the tools that are available when solving a mathematical problem, whether in a real-world or mathematical context. Choose tools that are relevant and useful to the problem at hand, such as drawings, diagrams, technologies, and physical objects and tools, as well as mathematical tools such as estimation or a particular strategy or algorithm.

Segment and Angle Bisectors

4.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

4.MP.6.a: Communicate precisely to others by crafting careful explanations that communicate mathematical reasoning by referring specifically to each important mathematical element, describing the relationships among them, and connecting their words clearly to representations. Calculate accurately and efficiently, and use clear and concise notation to record work.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

4.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

4.MP.7.a: Recognize and apply the structures of mathematics such as patterns, place value, the properties of operations, or the flexibility of numbers. See complicated things as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

4.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

4.MP.8.a: Notice repetitions in mathematics when solving multiple related problems. Use observations and reasoning to find shortcuts or generalizations. Evaluate the reasonableness of intermediate results.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

4.OA: Operations and Algebraic Thinking

Use the four operations with whole numbers (addition, subtraction, multiplication, and division) to solve problems.

4.OA.1: Interpret a multiplication equation as a comparison (for example, interpret 35 = 5 x 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5). Represent verbal statements of multiplicative comparisons as multiplication equations.

Chocomatic (Multiplication, Arrays, and Area)
Critter Count (Modeling Multiplication)

Factor Trees (Factoring Numbers)
Multiplying Decimals (Area Model)

4.OA.2: Multiply or divide to solve word problems involving multiplicative comparison, for example, by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.

Critter Count (Modeling Multiplication)
No Alien Left Behind (Division with Remainders)
Using Algebraic Equations

4.OA.3: Solve multi-step word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted.

Cannonball Clowns (Number Line Estimation)
Cargo Captain (Multi-digit Subtraction)
No Alien Left Behind (Division with Remainders)
Number Line Frog Hop (Addition and Subtraction)

4.OA.3.a: Represent these problems using equations with a letter standing for the unknown quantity.

Cannonball Clowns (Number Line Estimation)
Cargo Captain (Multi-digit Subtraction)
No Alien Left Behind (Division with Remainders)
Number Line Frog Hop (Addition and Subtraction)

4.OA.3.b: Assess the reasonableness of answers using mental computation and estimation strategies, including rounding.

Cannonball Clowns (Number Line Estimation)
Cargo Captain (Multi-digit Subtraction)
No Alien Left Behind (Division with Remainders)
Number Line Frog Hop (Addition and Subtraction)

Gain familiarity with factors and multiples.

4.OA.4: Find all factor pairs for a whole number in the range 1-100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1-100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1-100 is prime or composite.

Factor Trees (Factoring Numbers)

Generate and analyze numeric and shape patterns.

4.OA.5: 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.

Finding Patterns
Pattern Flip (Patterns)

4.NBT: Number and Operations in Base Ten

Generalize place value understanding for multi-digit whole numbers by analyzing patterns, writing whole numbers in a variety of ways, making comparisons, and rounding.

4.NBT.1: Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right.

Cannonball Clowns (Number Line Estimation)
Whole Numbers with Base-10 Blocks

4.NBT.2: Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Cannonball Clowns (Number Line Estimation)

4.NBT.3: Use place value understanding to round multi-digit whole numbers to any place.

Rounding Whole Numbers (Number Line)

Use place value understanding and properties of operations to perform multi-digit addition, subtraction, multiplication, and division using a one-digit divisor.

4.NBT.4: Fluently add and subtract multi-digit whole numbers using the standard algorithm.

Cargo Captain (Multi-digit Subtraction)
Target Sum Card Game (Multi-digit Addition)
Whole Numbers with Base-10 Blocks

4.NBT.6: Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

No Alien Left Behind (Division with Remainders)

4.NF: Number and Operations—Fractions

Extend understanding of equivalence and ordering of fractions.

4.NF.1: Explain why a fraction a/b is equivalent to a fraction (n x a)/(n x b) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.

Adding Fractions (Fraction Tiles)
Equivalent Fractions (Fraction Tiles)
Factor Trees (Factoring Numbers)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Modeling Fractions (Area Models)
Toy Factory (Set Models of Fractions)

4.NF.2: Compare two fractions with different numerators and different denominators, for example, by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, for example, by using a visual fraction model.

Adding Fractions (Fraction Tiles)
Equivalent Fractions (Fraction Tiles)
Factor Trees (Factoring Numbers)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Modeling Fractions (Area Models)
Toy Factory (Set Models of Fractions)

Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

4.NF.3: Understand a fraction a/b with a >1 as a sum of fractions 1/b. In other words, any fraction is a sum of unit fractions.

4.NF.3.a: Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.

Adding Fractions (Fraction Tiles)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)

4.NF.3.b: Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, for example, by using a visual fraction model.

Adding Fractions (Fraction Tiles)
Equivalent Fractions (Fraction Tiles)
Factor Trees (Factoring Numbers)
Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Modeling Fractions (Area Models)
Toy Factory (Set Models of Fractions)

4.NF.3.c: Add and subtract mixed numbers with like denominators, for example, by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction.

Fractions Greater than One (Fraction Tiles)

4.NF.3.d: Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators,

Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)

4.NF.4: Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.

4.NF.4.a: Understand a fraction a/b as a multiple of 1/b.

Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Modeling Fractions (Area Models)

4.NF.4.b: Understand a multiple of a/b as a multiple of 1/b, and use this understanding to multiply a fraction by a whole number.

Fraction Artist 1 (Area Models of Fractions)
Fraction Artist 2 (Area Models of Fractions)
Modeling Fractions (Area Models)

Understand decimal notation to the hundredths and compare decimal fractions with denominators of 10 and 100.

4.NF.6: Use decimal notation for fractions with denominators 10 or 100. For example, rewrite 0.62 as 62/100, describe a length as 0.62 meters; locate 0.62 on a number line diagram.

Fraction, Decimal, Percent (Area and Grid Models)
Modeling Decimals (Area and Grid Models)

4.NF.7: Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, for example, by using a visual model.

Adding Whole Numbers and Decimals (Base-10 Blocks)
Modeling Decimals (Area and Grid Models)
Modeling Whole Numbers and Decimals (Base-10 Blocks)
Subtracting Whole Numbers and Decimals (Base-10 Blocks)
Treasure Hunter (Decimals on the Number Line)

4.MD: Measurement and Data

Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

4.MD.1: Know relative sizes of measurement units within each system of units (standard and metric), including kilometers, meters, and centimeters; liters and milliliters; kilograms and grams; pounds and ounces; hours, minutes, and seconds. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

Cannonball Clowns (Number Line Estimation)

4.MD.2: Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money.

Elapsed Time
Road Trip (Problem Solving)

4.MD.2.a: Include problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit.

Elapsed Time
Road Trip (Problem Solving)
Toy Factory (Set Models of Fractions)

4.MD.2.b: Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

Elapsed Time
Road Trip (Problem Solving)

Apply knowledge of area and perimeter to solve real-world and mathematical problems.

4.MD.3: Apply the area and perimeter formulas for rectangles in real-world and mathematical problems.

Chocomatic (Multiplication, Arrays, and Area)

Understand various concepts of angles and angle measurement.

4.MD.7: Recognize angle measure as additive.

Polygon Angle Sum

4.MD.7.a: Understand that when an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts.

Polygon Angle Sum

4.MD.7.b: Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, for example by using an equation with a symbol for the unknown angle measure.

Polygon Angle Sum

4.G: Geometry

Draw and identify lines and angles, as well as classify shapes by properties of their lines and angles.

4.G.1: Draw points, lines, line segments, rays, angles (right, acute, and obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

City Tour (Coordinates)
Classifying Quadrilaterals
Elevator Operator (Line Graphs)

4.G.2: Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

Classifying Quadrilaterals
Classifying Triangles
Parallelogram Conditions

4.G.3: Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

Quilting Bee (Symmetry)

Fifth Grade

5.MP: Mathematical Practices

Students become mathematically proficient in engaging with mathematical content and concepts as they learn, experience, and apply these skills and attitudes.

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

Biconditional Statements
Conditional Statements
Estimating Population Size
Pattern Flip (Patterns)

5.MP.1.a: Explain the meaning of a problem, look for entry points to begin work on the problem, and plan and choose a solution pathway. When a solution pathway does not make sense, look for another pathway that does. Explain connections between various solution strategies and representations. Upon finding a solution, look back at the problem to determine whether the solution is reasonable and accurate, often checking answers to problems using a different method or approach.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Expressions

5.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

5.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

5.MP.3.a: Use stated assumptions, definitions, and previously established results to construct arguments. Explain and justify the mathematical reasoning underlying a strategy, solution, or conjecture by using concrete referents such as objects, drawings, diagrams, and actions. Listen to or read the arguments of others, decide whether they make sense, ask useful questions to clarify or improve the arguments, and build on those arguments.

Biconditional Statements
Conditional Statements

5.MP.4: Model with mathematics.

Estimating Sums and Differences

5.MP.5: Use appropriate tools strategically.

Elapsed Time

5.MP.5.a: Consider the tools that are available when solving a mathematical problem, whether in a real-world or mathematical context. Choose tools that are relevant and useful to the problem at hand, such as drawings, diagrams, technologies, and physical objects and tools, as well as mathematical tools such as estimation or a particular strategy or algorithm.

Segment and Angle Bisectors

5.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

5.MP.6.a: Communicate precisely to others by crafting careful explanations that communicate mathematical reasoning by referring specifically to each important mathematical element, describing the relationships among them, and connecting

their words clearly to representations. Calculate accurately and efficiently, and use clear and concise notation to record work.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

5.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

5.MP.7.a: Recognize and apply the structures of mathematics such as patterns, place value, the properties of operations, or the flexibility of numbers. See complicated things as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

5.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

5.MP.8.a: Notice repetitions in mathematics when solving multiple related problems. Use observations and reasoning to find shortcuts or generalizations. Evaluate the reasonableness of intermediate results.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

5.OA: Operations and Algebraic Thinking

Write and interpret numerical expressions.

5.OA.1: Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

Order of Operations

Write and interpret numerical expressions, and analyze patterns and relationships.

5.OA.3: 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.

City Tour (Coordinates)
Function Machines 1 (Functions and Tables)
Function Machines 2 (Functions, Tables, and Graphs)
Points, Lines, and Equations

5.NBT: Number and Operations in Base Ten

Understand the place value system.

5.NBT.1: Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

Cannonball Clowns (Number Line Estimation)
Modeling Decimals (Area and Grid Models)

Treasure Hunter (Decimals on the Number Line)
Whole Numbers with Base-10 Blocks

5.NBT.3: Read, write, and compare decimals to thousandths.

5.NBT.3.a: Read and write decimals to thousandths using base-ten numerals, number names, and expanded form. For example, 347.392 = 3 x 100 + 4 x 10 + 7 x 1 + 3 x (1/10) + 9 x (1/100) + 2 x (1/1000).

Comparing and Ordering Decimals
Modeling Decimals (Area and Grid Models)
Modeling Whole Numbers and Decimals (Base-10 Blocks)
Treasure Hunter (Decimals on the Number Line)

5.NBT.3.b: Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Comparing and Ordering Decimals
Treasure Hunter (Decimals on the Number Line)

Perform operations with multi-digit whole numbers and with decimals to hundredths.

5.NBT.6: Find whole-number quotients of whole numbers with up to four-digit dividends and two- digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

Critter Count (Modeling Multiplication)
Factor Trees (Factoring Numbers)
No Alien Left Behind (Division with Remainders)
Pattern Flip (Patterns)

5.NBT.7: Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. In this standard, dividing decimals is limited to a whole number dividend with a decimal divisor or a decimal dividend with a whole number divisor. Compare the value of the quotient on the basis of the values of the dividend and divisor.

Adding Whole Numbers and Decimals (Base-10 Blocks)
Multiplying Decimals (Area Model)
Multiplying with Decimals
Subtracting Whole Numbers and Decimals (Base-10 Blocks)
Sums and Differences with Decimals

5.NF: Number and Operations—Fractions

Use equivalent fractions as a strategy to add and subtract fractions.

5.NF.1: Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.

Fraction Artist 2 (Area Models of Fractions)
Fractions with Unlike Denominators

5.NF.2: Solve real-world problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators by, for example, using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers.

Fraction Artist 2 (Area Models of Fractions)
Fractions Greater than One (Fraction Tiles)

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

5.NF.3: Interpret a fraction as division of the numerator by the denominator (a/b = a ÷ b). Solve real-world problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, through the use of visual fraction models or equations to represent the problem.

Fraction Artist 1 (Area Models of Fractions)

5.NF.4: Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.

5.NF.4.a: Interpret the product (a/b) x q as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations a x q ÷ b using a visual fraction model.

Multiplying Fractions

5.NF.4.b: Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.

Multiplying Fractions

5.NF.6: Solve real-world problems involving multiplication of fractions and mixed numbers, for example, by using visual fraction models or equations to represent the problem.

Multiplying Fractions

5.MD: Measurement and Data

Convert like measurement units within a given measurement system.

5.MD.1: Convert among different-sized standard measurement units within a given measurement system (for example, convert 5 cm to 0.05 m); use these conversions in solving multi-step, real-world problems.

Cannonball Clowns (Number Line Estimation)

Understand concepts of geometric measurement and volume, as well as how multiplication and addition relate to volume.

5.MD.3: Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

5.MD.3.a: A cube with side length one unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.

Balancing Blocks (Volume)
Pyramids and Cones

5.MD.3.b: A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units.

Balancing Blocks (Volume)
Pyramids and Cones

5.MD.4: Measure volumes by counting unit cubes, using cubic cm, cubic in., cubic ft., and improvised units.

Balancing Blocks (Volume)

5.MD.5: Relate volume to the operations of multiplication and addition and solve real-world and mathematical problems involving volume.

5.MD.5.a: Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, for example, to represent the associative property of multiplication.

Balancing Blocks (Volume)
Prisms and Cylinders

5.MD.5.b: Apply the formulas V = l x w x h and V = b x h for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real-world and mathematical problems.

Balancing Blocks (Volume)
Prisms and Cylinders

5.G: Geometry

Graph points on the coordinate plane to solve real-world and mathematical problems in quadrant one.

5.G.1: Compose and understand the coordinate plane.

5.G.1.a: Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the zero on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates.

City Tour (Coordinates)
Elevator Operator (Line Graphs)
Function Machines 2 (Functions, Tables, and Graphs)
Function Machines 3 (Functions and Problem Solving)
Points in the Coordinate Plane
Points, Lines, and Equations

5.G.1.b: Using quadrant one on the coordinate plane, understand that the first number in a coordinate pair indicates how far to travel from the origin in the direction of the horizontal axis, and the second number indicates how far to travel in the direction of the vertical axis, with the convention that the names of the two axes and the coordinates correspond (x-axis and x-coordinate, y-axis and y-coordinate).

City Tour (Coordinates)
Elevator Operator (Line Graphs)
Function Machines 2 (Functions, Tables, and Graphs)
Function Machines 3 (Functions and Problem Solving)
Points in the Coordinate Plane
Points, Lines, and Equations

5.G.2: Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

City Tour (Coordinates)
Elevator Operator (Line Graphs)
Function Machines 2 (Functions, Tables, and Graphs)
Points in the Coordinate Plane
Points, Lines, and Equations

Classify two-dimensional figures into categories based on their properties.

Classifying Quadrilaterals
Classifying Triangles
Parallelogram Conditions
Special Parallelograms

5.G.3: Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and all squares are rectangles, so all squares have four right angles.

Classifying Quadrilaterals

5.G.4: Classify two-dimensional figures in a hierarchy based on properties.

Classifying Quadrilaterals
Parallelogram Conditions
Special Parallelograms

Sixth Grade

6.MP: Mathematical practice

Students become mathematically proficient in engaging with mathematical content and concepts as they learn, experience, and apply these skills and attitudes.

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

Biconditional Statements
Conditional Statements

Estimating Population Size
Pattern Flip (Patterns)

6.MP.1.a: Explain the meaning of a problem and look for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution, plan a solution pathway, and continually monitor progress asking, "Does this make sense?" Consider analogous problems, make connections between multiple representations, identify the correspondence between different approaches, look for trends, and transform algebraic expressions to highlight meaningful mathematics. Check answers to problems using a different method.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Expressions

6.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

6.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

6.MP.3.a: Understand and use stated assumptions, definitions, and previously established results in constructing arguments. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. Justify conclusions and communicate them to others. Respond to the arguments of others by listening, asking clarifying questions, and critiquing the reasoning of others.

Biconditional Statements
Conditional Statements

6.MP.4: Model with mathematics.

Estimating Sums and Differences

6.MP.5: Use appropriate tools strategically.

Elapsed Time

6.MP.5.a: Consider the available tools and be sufficiently familiar with them to make sound decisions about when each tool might be helpful, recognizing both the insight to be gained as well as the limitations. Identify relevant external mathematical resources and use them to pose or solve problems. Use tools to explore and deepen their understanding of concepts.

Segment and Angle Bisectors

6.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

6.MP.6.a: Communicate precisely to others. Use explicit definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose. Specify units of measure and label axes to clarify the correspondence with quantities in a problem. Calculate accurately and efficiently, and express numerical answers with a degree of precision appropriate for the problem context.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

6.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

6.MP.7.a: Look closely at mathematical relationships to identify the underlying structure by recognizing a simple structure within a more complicated structure. See complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, see 5 – 3(x – y)2 as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

6.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

6.MP.8.a: Notice if reasoning is repeated, and look for both generalizations and shortcuts. Evaluate the reasonableness of intermediate results by maintaining oversight of the process while attending to the details.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

6.RP: Ratios and Proportional Relationships

Understand ratio concepts and use ratio reasoning to solve problems.

6.RP.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. The following are examples of ratio language: “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every two wings there was one beak.” “For every vote candidate A received, candidate C received nearly three votes.”

Beam to Moon (Ratios and Proportions)
Part-to-part and Part-to-whole Ratios
Proportions and Common Multipliers
Road Trip (Problem Solving)

6.RP.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. The following are examples of rate language: 'This recipe has a ratio of four cups of flour to two cups of sugar, so the rate is two cups of flour for each cup of sugar.” “We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger.”' (In sixth grade, unit rates are limited to non-complex fractions.)

Beam to Moon (Ratios and Proportions)
Household Energy Usage
Road Trip (Problem Solving)

6.RP.3: Use ratio and rate reasoning to solve real-world (with a context) and mathematical (void of context) problems, using strategies such as reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations involving unit rate problems.

6.RP.3.b: Solve unit rate problems including those involving unit pricing and constant speed.

Road Trip (Problem Solving)

6.RP.3.c: Find a percent of a quantity as a rate per 100. Solve problems involving finding the whole, given a part and the percent. (For example, 30% of a quantity means 30/100 times the quantity.)

Percent of Change
Percents and Proportions
Percents, Fractions, and Decimals
Polling: Neighborhood
Real-Time Histogram
Time Estimation

6.RP.3.d: Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

Unit Conversions

6.NS: The Number System

Apply and extend previous understandings of multiplication and division of whole numbers to divide fractions by fractions.

6.NS.1: Interpret and compute quotients of fractions.

6.NS.1.a: Compute quotients of fractions by fractions, for example, by applying strategies such as visual fraction models, equations, and the relationship between multiplication and division, to represent problems.

Dividing Fractions
Dividing Mixed Numbers

6.NS.1.b: Solve real-world problems involving division of fractions by fractions. For example, how much chocolate will each person get if three people share 1/2 pound of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mile and area 1/2 square mile?

Dividing Fractions
Dividing Mixed Numbers

Compute (add, subtract, multiply and divide) fluently with multi-digit numbers and decimals and find common factors and multiples.

6.NS.3: Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.

Adding Whole Numbers and Decimals (Base-10 Blocks)
Multiplying Decimals (Area Model)
Multiplying with Decimals
Subtracting Whole Numbers and Decimals (Base-10 Blocks)
Sums and Differences with Decimals

6.NS.3.a: Fluently divide multi-digit decimals using the standard algorithm, limited to a whole number dividend with a decimal divisor or a decimal dividend with a whole number divisor.

No Alien Left Behind (Division with Remainders)

6.NS.4: Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor.

Pattern Flip (Patterns)

Apply and extend previous understandings of numbers to the system of rational numbers.

6.NS.5: Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (for example, temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of zero in each situation.

Adding and Subtracting Integers
Adding on the Number Line
Addition of Polynomials
Integers, Opposites, and Absolute Values

6.NS.6: Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.

6.NS.6.a: Recognize opposite signs of numbers as indicating locations on opposite sides of zero on the number line; recognize that the opposite of the opposite of a number is the number itself.

Adding and Subtracting Integers
Adding on the Number Line
Integers, Opposites, and Absolute Values
Rational Numbers, Opposites, and Absolute Values
Solving Algebraic Equations I

6.NS.6.b: Understand that the signs of numbers in ordered pairs indicate their location in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.

Points in the Coordinate Plane

6.NS.6.c: Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

Integers, Opposites, and Absolute Values
Modeling Fractions (Area Models)
Points in the Coordinate Plane

6.NS.7: Understand ordering and absolute value of rational numbers.

6.NS.7.a: Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram.

Integers, Opposites, and Absolute Values

6.NS.7.c: Understand the absolute value of a rational number as its distance from zero on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world context.

Absolute Value with Linear Functions
Integers, Opposites, and Absolute Values
Rational Numbers, Opposites, and Absolute Values

6.NS.7.d: Distinguish comparisons of absolute value from statements about order.

Integers, Opposites, and Absolute Values

6.NS.8: Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same x-coordinate or the same y-coordinate.

City Tour (Coordinates)
Elevator Operator (Line Graphs)
Points in the Coordinate Plane
Points, Lines, and Equations
Slope

6.EE: Expressions and Equations

Apply and extend previous understandings of arithmetic to algebraic expressions involving exponents and variables.

6.EE.1: Write and evaluate numerical expressions involving whole-number exponents.

Order of Operations

6.EE.2: Write, read, and evaluate expressions in which letters represent numbers.

6.EE.2.a: Write expressions that record operations with numbers and with letters representing numbers.

Solving Equations on the Number Line
Using Algebraic Equations
Using Algebraic Expressions

6.EE.2.b: Identify parts of an expression using mathematical terms (for example, sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity and a sum of two terms.

Compound Interest
Equivalent Algebraic Expressions II
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II
Using Algebraic Equations
Using Algebraic Expressions

6.EE.2.c: Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, applying the Order of Operations when there are no parentheses to specify a particular order.

Equivalent Algebraic Expressions I
Equivalent Algebraic Expressions II
Order of Operations
Solving Equations on the Number Line

6.EE.3: Apply the properties of operations to generate equivalent expressions.

Equivalent Algebraic Expressions I
Equivalent Algebraic Expressions II
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II
Solving Algebraic Equations II

6.EE.4: Identify when two expressions are equivalent.

Equivalent Algebraic Expressions I
Equivalent Algebraic Expressions II
Modeling the Factorization of x^2+bx+c
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II

They reason about and solve one-variable equations and inequalities.

6.EE.5: Understand solving an equation or inequality as a process of answering the question: Which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.

Compound Inequalities
Exploring Linear Inequalities in One Variable
Linear Inequalities in Two Variables
Solving Algebraic Equations II
Solving Equations on the Number Line
Solving Linear Inequalities in One Variable

6.EE.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

Equivalent Algebraic Expressions I
Solving Algebraic Equations II

6.EE.7: Solve real-world and mathematical problems by writing and solving equations of the form x + a = b and ax = b for cases in which a, b and x are all non-negative rational numbers.

Absolute Value Equations and Inequalities
Modeling One-Step Equations
Solving Algebraic Equations I
Solving Algebraic Equations II
Solving Equations on the Number Line

6.EE.8: Write an inequality of the form x > c or x < c to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form x > c or x < c have infinitely many solutions; represent solutions of such inequalities on number line diagrams.

Absolute Value Equations and Inequalities
Comparing and Ordering Decimals
Compound Inequalities
Exploring Linear Inequalities in One Variable
Linear Inequalities in Two Variables
Rational Numbers, Opposites, and Absolute Values
Solving Linear Inequalities in One Variable

6.G: Geometry

Solve real-world and mathematical problems involving area, surface area, and volume.

6.G.1: Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing and decomposing into rectangles, triangles and/or other shapes; apply these techniques in the context of solving real-world and mathematical problems.

Area of Parallelograms
Area of Triangles
Chocomatic (Multiplication, Arrays, and Area)
Fido's Flower Bed (Perimeter and Area)
Perimeter and Area of Rectangles

6.G.2: Find the volume of a right rectangular prism with appropriate unit fraction edge lengths by packing it with cubes of the appropriate unit fraction edge lengths (for example, 3½ x 2 x 6), and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas V = lwh and V = bh to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems. (Note: Model the packing using drawings and diagrams.)

Prisms and Cylinders

6.G.3: Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same x coordinate or the same y coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

Points in the Coordinate Plane

6.G.4: Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

Surface and Lateral Areas of Prisms and Cylinders
Surface and Lateral Areas of Pyramids and Cones

6.SP: Statistics and Probability

Develop understanding of statistical variability of data.

6.SP.1: Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.

Polling: City
Polling: Neighborhood
Reaction Time 2 (Graphs and Statistics)

6.SP.2: Understand that a set of data collected to answer a statistical question has a distribution that can be described by its center, spread/range and overall shape.

Box-and-Whisker Plots
Describing Data Using Statistics
Mean, Median, and Mode
Movie Reviewer (Mean and Median)
Polling: City
Populations and Samples
Reaction Time 1 (Graphs and Statistics)
Reaction Time 2 (Graphs and Statistics)
Real-Time Histogram
Stem-and-Leaf Plots

6.SP.3: Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

Reaction Time 1 (Graphs and Statistics)
Reaction Time 2 (Graphs and Statistics)

Summarize and describe distributions.

6.SP.4: Display numerical data in plots on a number line, including dot plots, histograms and box plots. Choose the most appropriate graph/plot for the data collected.

Box-and-Whisker Plots
Histograms
Mascot Election (Pictographs and Bar Graphs)
Mean, Median, and Mode
Reaction Time 1 (Graphs and Statistics)
Reaction Time 2 (Graphs and Statistics)
Real-Time Histogram
Stem-and-Leaf Plots

6.SP.5: Summarize numerical data sets in relation to their context, such as by:

6.SP.5.b: Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.

Reaction Time 2 (Graphs and Statistics)
Time Estimation

6.SP.5.c: Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations (for example, outliers) from the overall pattern with reference to the context in which the data were gathered.

Box-and-Whisker Plots
Describing Data Using Statistics
Mean, Median, and Mode
Movie Reviewer (Mean and Median)
Populations and Samples
Reaction Time 1 (Graphs and Statistics)
Reaction Time 2 (Graphs and Statistics)
Real-Time Histogram
Sight vs. Sound Reactions
Stem-and-Leaf Plots

Seventh Grade

7.MP: Mathematical Practices

Students become mathematically proficient in engaging with mathematical content and concepts as they learn, experience, and apply these skills and attitudes.

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

Biconditional Statements
Conditional Statements
Estimating Population Size
Pattern Flip (Patterns)

7.MP.1.a: Explain the meaning of a problem and look for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution, plan a solution pathway, and continually monitor progress asking, “Does this make sense?” Consider analogous problems, make connections between multiple representations, identify the correspondence between different approaches, look for trends, and transform algebraic expressions to highlight meaningful mathematics. Check answers to problems using a different method.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)

Polling: City
Solving Equations on the Number Line
Using Algebraic Expressions

7.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

7.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

7.MP.3.a: Understand and use stated assumptions, definitions, and previously established results in constructing arguments. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. Justify conclusions and communicate them to others. Respond to the arguments of others by listening, asking clarifying questions, and critiquing the reasoning of others.

Biconditional Statements
Conditional Statements

7.MP.4: Model with mathematics.

Estimating Sums and Differences

7.MP.5: Use appropriate tools strategically.

Elapsed Time

7.MP.5.a: Consider the available tools and be sufficiently familiar with them to make sound decisions about when each tool might be helpful, recognizing both the insight to be gained as well as the limitations. Identify relevant external mathematical resources and use them to pose or solve problems. Use tools to explore and deepen their understanding of concepts.

Segment and Angle Bisectors

7.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

7.MP.6.a: Communicate precisely to others. Use explicit definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose. Specify units of measure and label axes to clarify the correspondence with quantities in a problem. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

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

Pattern Flip (Patterns)

7.MP.7.a: Look closely at mathematical relationships to identify the underlying structure by recognizing a simple structure within a more complicated structure. See complicated things, such as some algebraic expressions, as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

7.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences

Pattern Finder
Pattern Flip (Patterns)

7.MP.8.a: Notice if reasoning is repeated, and look for both generalizations and shortcuts. Evaluate the reasonableness of intermediate results by maintaining oversight of the process while attending to the details.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

7.RP: Ratios and Proportional Relationships

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

7.RP.2: Recognize and represent proportional relationships between quantities.

7.RP.2.a: 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.

Direct and Inverse Variation
Proportions and Common Multipliers

7.RP.2.b: Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

Beam to Moon (Ratios and Proportions)
Dilations
Perimeters and Areas of Similar Figures
Similar Figures

7.RP.2.c: Represent proportional relationships by equations.

Beam to Moon (Ratios and Proportions)
Estimating Population Size
Geometric Probability
Polling: Neighborhood
Theoretical and Experimental Probability

7.RP.2.d: 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.

Direct and Inverse Variation

7.RP.3: Use proportional relationships to solve multi-step ratio and percent problems.

Beam to Moon (Ratios and Proportions)
Estimating Population Size
Part-to-part and Part-to-whole Ratios
Percent of Change
Percents and Proportions
Percents, Fractions, and Decimals
Polling: Neighborhood
Proportions and Common Multipliers

7.NS: The Number System

Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

7.NS.1: Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.

7.NS.1.a: Describe situations in which opposite quantities combine to make 0.

Adding and Subtracting Integers
Adding and Subtracting Integers with Chips
Integers, Opposites, and Absolute Values

7.NS.1.b: Understand p + q as the number located a distance |q| from p in the positive or negative direction, depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.

Adding and Subtracting Integers
Adding on the Number Line
Improper Fractions and Mixed Numbers
Integers, Opposites, and Absolute Values
Rational Numbers, Opposites, and Absolute Values
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II
Solving Algebraic Equations I
Sums and Differences with Decimals

7.NS.1.c: Understand subtraction of rational numbers as adding the additive inverse, p – q = p + (–q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.

Adding and Subtracting Integers
Adding and Subtracting Integers with Chips
Adding on the Number Line
Equivalent Algebraic Expressions I
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II
Solving Algebraic Equations I
Sums and Differences with Decimals

7.NS.1.d: Apply properties of operations as strategies to add and subtract rational numbers.

Adding and Subtracting Integers with Chips

7.NS.2: Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.

7.NS.2.b: Understand that integers can be divided, provided the divisor is not zero, and that every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then –(p/q) = (–p)/q = p/(–q). Interpret quotients of rational numbers by describing real-world contexts.

Dividing Mixed Numbers

7.NS.3: Solve real-world and mathematical problems involving the four operations with rational numbers. Computations with rational numbers extend the rules for manipulating fractions to complex fractions.

Adding Fractions (Fraction Tiles)
Adding and Subtracting Integers
Adding on the Number Line
Dividing Fractions
Dividing Mixed Numbers
Estimating Population Size
Estimating Sums and Differences
Fractions Greater than One (Fraction Tiles)
Improper Fractions and Mixed Numbers
Multiplying Fractions
Multiplying Mixed Numbers
Multiplying with Decimals
Sums and Differences with Decimals

7.EE: Expressions and Equations

Use properties of operations to generate equivalent expressions.

7.EE.1: Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

Equivalent Algebraic Expressions I
Equivalent Algebraic Expressions II
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II

Solving Algebraic Equations I
Solving Algebraic Equations II

7.EE.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.

Exponents and Power Rules
Modeling the Factorization of ax^2+bx+c
Modeling the Factorization of x^2+bx+c

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

7.EE.3: 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.

Adding Fractions (Fraction Tiles)
Adding Whole Numbers and Decimals (Base-10 Blocks)
Adding and Subtracting Integers
Adding on the Number Line
Dividing Fractions
Dividing Mixed Numbers
Estimating Sums and Differences
Fraction Garden (Comparing Fractions)
Fractions Greater than One (Fraction Tiles)
Fractions with Unlike Denominators
Improper Fractions and Mixed Numbers
Multiplying Fractions
Multiplying Mixed Numbers
Multiplying with Decimals
Part-to-part and Part-to-whole Ratios
Percent of Change
Percents and Proportions
Percents, Fractions, and Decimals
Subtracting Whole Numbers and Decimals (Base-10 Blocks)
Sums and Differences with Decimals
Toy Factory (Set Models of Fractions)

7.EE.4: 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.

7.EE.4.a: 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.

Absolute Value Equations and Inequalities
Circles
Modeling One-Step Equations
Modeling and Solving Two-Step Equations
Order of Operations
Solving Algebraic Equations I
Solving Algebraic Equations II
Solving Equations on the Number Line
Solving Two-Step Equations

7.EE.4.b: 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.

Absolute Value Equations and Inequalities
Rational Numbers, Opposites, and Absolute Values
Solving Linear Inequalities in One Variable

7.G: Geometry

Draw, construct, and describe geometrical figures, and describe the relationships between them.

7.G.1: Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

Dilations
Perimeters and Areas of Similar Figures
Similar Figures

Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

7.G.4: Know the formulas for the area and circumference of a circle, and solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

Circumference and Area of Circles

7.G.5: Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write, and use them to solve simple equations for an unknown angle in a figure.

Investigating Angle Theorems
Triangle Angle Sum

7.G.6: Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Area of Parallelograms
Balancing Blocks (Volume)
Perimeter and Area of Rectangles
Prisms and Cylinders
Pyramids and Cones
Surface and Lateral Areas of Pyramids and Cones

7.SP: Statistics and Probability

Use random sampling to draw inferences about a population.

7.SP.1: Understand that statistics can be used to gain information about a population by examining a sample of the population, and that generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling is more likely to produce representative samples and support valid inferences.

Polling: City
Polling: Neighborhood
Populations and Samples

7.SP.2: Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions.

Estimating Population Size
Polling: City
Polling: Neighborhood
Populations and Samples

Draw informal comparative inferences about two populations.

7.SP.3: Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, estimating the difference between the centers by expressing it as a multiple of a measure of variability.

Box-and-Whisker Plots
Describing Data Using Statistics
Mean, Median, and Mode

Movie Reviewer (Mean and Median)
Reaction Time 1 (Graphs and Statistics)
Reaction Time 2 (Graphs and Statistics)
Real-Time Histogram

7.SP.4: Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.

Box-and-Whisker Plots
Reaction Time 1 (Graphs and Statistics)
Real-Time Histogram

Investigate chance processes and develop, use, and evaluate probability models.

7.SP.5: Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

Geometric Probability
Independent and Dependent Events
Probability Simulations
Spin the Big Wheel! (Probability)
Theoretical and Experimental Probability

7.SP.6: Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability.

Lucky Duck (Expected Value)
Probability Simulations
Theoretical and Experimental Probability

7.SP.7: Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.

7.SP.7.a: Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events.

Independent and Dependent Events
Probability Simulations

7.SP.7.b: Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.

Lucky Duck (Expected Value)

7.SP.8: Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

7.SP.8.a: Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.

Independent and Dependent Events

7.SP.8.b: Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the event.

Independent and Dependent Events
Permutations and Combinations

7.SP.8.c: Design and use a simulation to generate frequencies for compound events.

Independent and Dependent Events

Eighth Grade

8.MP: Mathematical Practices

Students become mathematically proficient in engaging with mathematical content and concepts as they learn, experience, and apply these skills and attitudes.

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

Biconditional Statements
Conditional Statements
Estimating Population Size
Pattern Flip (Patterns)

8.MP.1.a: Explain the meaning of a problem and look for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution, plan a solution pathway, and continually monitor progress asking, “Does this make sense?” Consider analogous problems, make connections between multiple representations, identify the correspondence between different approaches, look for trends, and transform algebraic expressions to highlight meaningful mathematics. Check answers to problems using a different method.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Expressions

8.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

8.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

8.MP.3.a: Understand and use stated assumptions, definitions, and previously established results in constructing arguments. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. Justify conclusions and communicate them to others. Respond to the arguments of others by listening, asking clarifying questions, and critiquing the reasoning of others.

Biconditional Statements
Conditional Statements

8.MP.4: Model with mathematics.

Estimating Sums and Differences

8.MP.5: Use appropriate tools strategically.

Elapsed Time

8.MP.5.a: Consider the available tools and be sufficiently familiar with them to make sound decisions about when each tool might be helpful, recognizing both the insight to be gained as well as the limitations. Identify relevant external mathematical resources and use them to pose or solve problems. Use tools to explore and deepen their understanding of concepts.

Segment and Angle Bisectors

8.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

8.MP.6.a: Communicate precisely to others. Use explicit definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose. Specify units of measure and label axes to clarify the

correspondence with quantities in a problem. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

8.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

8.MP.7.a: Look closely at mathematical relationships to identify the underlying structure by recognizing a simple structure within a more complicated structure. See complicated things, such as some algebraic expressions, as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

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

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

8.MP.8.a: Notice if reasoning is repeated, and look for both generalizations and shortcuts. Evaluate the reasonableness of intermediate results by maintaining oversight of the process while attending to the details.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

8.NS: Number System

Know that there are numbers that are not rational, and approximate them by rational numbers.

8.NS.1: Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers, show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

Part-to-part and Part-to-whole Ratios
Percents, Fractions, and Decimals

8.NS.2: Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2).

Circumference and Area of Circles
Ordering and Approximating Square Roots

8.NS.3: Understand how to perform operations and simplify radicals with emphasis on square roots.

Operations with Radical Expressions
Simplifying Radical Expressions

8.EE: Expressions and Equations

Work with radical and integer exponents.

8.EE.1: Know and apply the properties of integer exponents to generate equivalent numerical expressions.

Dividing Exponential Expressions
Exponents and Power Rules
Multiplying Exponential Expressions
Simplifying Algebraic Expressions II

8.EE.2: Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

Operations with Radical Expressions
Simplifying Radical Expressions
Square Roots

8.EE.3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.

Unit Conversions 2 - Scientific Notation and Significant Digits

8.EE.4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

Unit Conversions
Unit Conversions 2 - Scientific Notation and Significant Digits

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

8.EE.5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.

Direct and Inverse Variation
Distance-Time Graphs
Distance-Time and Velocity-Time Graphs

8.EE.6: 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.

Linear Inequalities in Two Variables
Point-Slope Form of a Line
Points, Lines, and Equations
Slope-Intercept Form of a Line
Standard Form of a Line

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

8.EE.7: Solve linear equations and inequalities in one variable.

8.EE.7.a: 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).

Modeling One-Step Equations
Modeling and Solving Two-Step Equations
Solving Algebraic Equations II
Solving Equations by Graphing Each Side
Solving Equations on the Number Line
Solving Two-Step Equations

8.EE.7.b: Solve single-variable linear equations and inequalities with rational number coefficients, including equations and inequalities whose solutions require expanding expressions using the distributive property and collecting like terms.

Absolute Value Equations and Inequalities
Compound Inequalities
Exploring Linear Inequalities in One Variable

Linear Inequalities in Two Variables
Modeling One-Step Equations
Modeling and Solving Two-Step Equations
Solving Algebraic Equations I
Solving Algebraic Equations II
Solving Equations by Graphing Each Side
Solving Equations on the Number Line
Solving Linear Inequalities in One Variable
Solving Two-Step Equations

8.EE.7.c: Solve single-variable absolute value equations.

Absolute Value Equations and Inequalities

8.EE.8: Analyze and solve pairs of simultaneous linear equations.

8.EE.8.a: 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.

Solving Linear Systems (Slope-Intercept Form)
Solving Linear Systems (Standard Form)

8.EE.8.b: Solve systems of two linear equations in two variables graphically, approximating when solutions are not integers and estimate solutions by graphing the equations. Solve simple cases by inspection.

Cat and Mouse (Modeling with Linear Systems)
Solving Equations by Graphing Each Side
Solving Linear Systems (Matrices and Special Solutions)
Solving Linear Systems (Slope-Intercept Form)
Solving Linear Systems (Standard Form)

8.EE.8.c: Solve real-world and mathematical problems leading to two linear equations in two variables graphically.

Cat and Mouse (Modeling with Linear Systems)
Solving Equations by Graphing Each Side
Solving Linear Systems (Matrices and Special Solutions)
Solving Linear Systems (Slope-Intercept Form)
Solving Linear Systems (Standard Form)

8.F: Functions

Define, evaluate, and compare functions.

8.F.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.

Function Machines 1 (Functions and Tables)
Function Machines 2 (Functions, Tables, and Graphs)
Introduction to Functions
Points, Lines, and Equations

8.F.2: Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Function Machines 2 (Functions, Tables, and Graphs)
Graphs of Polynomial Functions
Linear Functions
Quadratics in Polynomial Form

8.F.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.

Absolute Value with Linear Functions
Linear Functions
Point-Slope Form of a Line
Points, Lines, and Equations
Slope-Intercept Form of a Line
Standard Form of a Line

Use functions to model relationships between quantities.

8.F.4: 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.

Arithmetic Sequences
Cat and Mouse (Modeling with Linear Systems)
Compound Interest
Function Machines 1 (Functions and Tables)
Function Machines 2 (Functions, Tables, and Graphs)
Function Machines 3 (Functions and Problem Solving)
Linear Functions
Points, Lines, and Equations
Slope-Intercept Form of a Line
Translating and Scaling Functions

8.F.5: 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.

Distance-Time Graphs
Distance-Time and Velocity-Time Graphs
Linear Functions

8.G: Geometry

Understand congruence and similarity using physical models, transparencies, or geometry software.

8.G.1: Verify experimentally the properties of rotations, reflections, and translations:

8.G.1.a: Lines are taken to lines, and line segments to line segments of the same length.

Reflections
Rotations, Reflections, and Translations
Similar Figures
Translations

8.G.1.b: Angles are taken to angles of the same measure.

Reflections
Rotations, Reflections, and Translations
Similar Figures
Translations

8.G.1.c: Parallel lines are taken to parallel lines.

Reflections
Rotations, Reflections, and Translations
Similar Figures
Translations

8.G.3: Observe that orientation of the plane is preserved in rotations and translations, but not with reflections. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

Dilations
Rock Art (Transformations)
Rotations, Reflections, and Translations
Translations

8.G.5: Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.

Investigating Angle Theorems
Similar Figures
Triangle Angle Sum

Understand and apply the Pythagorean Theorem and its converse.

8.G.6: Explore and explain proofs of the Pythagorean Theorem and its converse.

Pythagorean Theorem
Pythagorean Theorem with a Geoboard

8.G.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Pythagorean Theorem
Pythagorean Theorem with a Geoboard

8.G.8: Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Distance Formula
Pythagorean Theorem

Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

8.G.9: Know the formulas for the volumes of cones, cylinders, and spheres, and use them to solve real-world and mathematical problems.

Prisms and Cylinders
Pyramids and Cones

8.SP: Statistics and Probability

Investigate patterns of association in bivariate data.

8.SP.1: Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

Correlation
Solving Using Trend Lines
Trends in Scatter Plots

8.SP.2: Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

Correlation
Solving Using Trend Lines

8.SP.3: Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

Solving Using Trend Lines

Mathematics I

SI.MP: Mathematical Practices

Students become mathematically proficient in engaging with mathematical content and concepts as they learn, experience, and apply these skills and attitudes.

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

Biconditional Statements
Conditional Statements

Estimating Population Size
Pattern Flip (Patterns)

SI.MP.1.a: Explain the meaning of a problem and look for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution, plan a solution pathway, and continually monitor progress asking, "Does this make sense?" Consider analogous problems, make connections between multiple representations, identify the correspondence between different approaches, look for trends, and transform algebraic expressions to highlight meaningful mathematics. Check answers to problems using a different method.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Expressions

SI.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

SI.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

SI.MP.3.a: Understand and use stated assumptions, definitions, and previously established results in constructing arguments. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. Justify conclusions and communicate them to others. Respond to the arguments of others by listening, asking clarifying questions, and critiquing the reasoning of others.

Biconditional Statements
Conditional Statements

SI.MP.4: Model with mathematics.

Estimating Sums and Differences

SI.MP.5: Use appropriate tools strategically.

Elapsed Time

SI.MP.5.a: Consider the available tools and be sufficiently familiar with them to make sound decisions about when each tool might be helpful, recognizing both the insight to be gained as well as the limitations. Identify relevant external mathematical resources and use them to pose or solve problems. Use tools to explore and deepen their understanding of concepts.

Segment and Angle Bisectors

SI.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

SI.MP.6.a: Communicate precisely to others. Use explicit definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose. Specify units of measure and label axes to clarify the correspondence with quantities in a problem. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

SI.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

SI.MP.7.a: Look closely at mathematical relationships to identify the underlying structure by recognizing a simple structure within a more complicated structure. See complicated things, such as some algebraic expressions, as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

SI.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

SI.MP.8.a: Notice if reasoning is repeated, and look for both generalizations and shortcuts. Evaluate the reasonableness of intermediate results by maintaining oversight of the process while attending to the details.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

A: Algebra

A.SSE: Seeing Structure in Expressions

Interpret the structure of expressions.

A.SSE.1: Interpret linear expressions and exponential expressions with integer exponents that represent a quantity in terms of its context.

A.SSE.1.a: Interpret parts of an expression, such as terms, factors, and coefficients.

Compound Interest
Exponential Growth and Decay
Unit Conversions

A.SSE.1.b: Interpret complicated expressions by viewing one or more of their parts as a single entity.

Compound Interest
Exponential Growth and Decay
Translating and Scaling Functions
Using Algebraic Expressions

A.CED: Creating Equations

Create equations that describe numbers or relationships. Limit these to linear equations and inequalities, and exponential equations. In the case of exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs.

A.CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and simple exponential functions.

Absolute Value Equations and Inequalities
Absolute Value with Linear Functions
Arithmetic Sequences
Compound Interest
Exploring Linear Inequalities in One Variable
Exponential Functions
Geometric Sequences
Introduction to Exponential Functions
Linear Functions
Linear Inequalities in Two Variables
Logarithmic Functions
Modeling One-Step Equations

Modeling and Solving Two-Step Equations
Quadratic Inequalities
Slope-Intercept Form of a Line
Solving Equations on the Number Line
Solving Linear Inequalities in One Variable
Solving Two-Step Equations
Using Algebraic Equations

A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

2D Collisions
Air Track
Compound Interest
Determining a Spring Constant
Golf Range
Points, Lines, and Equations
Slope-Intercept Form of a Line

A.CED.3: Represent constraints by equations or inequalities and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.

Linear Inequalities in Two Variables
Linear Programming
Solving Linear Systems (Standard Form)
Systems of Linear Inequalities (Slope-intercept form)

A.CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Solving Formulas for any Variable

A.REI: Reasoning With Equations and Inequalities

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

A.REI.1: Explain each step in solving a linear 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. Students will solve exponential equations with logarithms in Secondary Mathematics III.

Modeling One-Step Equations
Modeling and Solving Two-Step Equations
Solving Algebraic Equations II
Solving Equations on the Number Line
Solving Formulas for any Variable
Solving Two-Step Equations

Solve equations and inequalities in one variable.

A.REI.3: Solve equations and inequalities in one variable.

A.REI.3.a: Solve one-variable equations and literal equations to highlight a variable of interest.

Absolute Value Equations and Inequalities
Area of Triangles
Modeling One-Step Equations
Modeling and Solving Two-Step Equations
Solving Algebraic Equations II
Solving Equations on the Number Line
Solving Formulas for any Variable
Solving Two-Step Equations

A.REI.3.b: Solve compound inequalities in one variable, including absolute value inequalities.

Absolute Value Equations and Inequalities
Compound Inequalities
Solving Linear Inequalities in One Variable

A.REI.3.c: Solve simple exponential equations that rely only on application of the laws of exponents (limit solving exponential equations to those that can be solved without logarithms). For example, $5^x = 125$ or $2^x = 1/16$.

Exponential Functions

Solve systems of equations. Build on student experiences graphing and solving systems of linear equations from middle school. Include cases where the two equations describe the same line—yielding infinitely many solutions—and cases where two equations describe parallel lines—yielding no solution; connect to GPE.5, which requires students to prove the slope criteria for parallel lines.

A.REI.5: Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

Solving Linear Systems (Slope-Intercept Form)
Solving Linear Systems (Standard Form)

A.REI.6: Solve systems of linear equations exactly and approximately (numerically, algebraically, graphically), focusing on pairs of linear equations in two variables.

Cat and Mouse (Modeling with Linear Systems)
Solving Equations by Graphing Each Side
Solving Linear Systems (Matrices and Special Solutions)
Solving Linear Systems (Slope-Intercept Form)
Solving Linear Systems (Standard Form)

Represent and solve equations and inequalities graphically.

A.REI.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Circles
Ellipses
Hyperbolas
Parabolas
Points, Lines, and Equations

A.REI.11: Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately; e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear and exponential functions.

Cat and Mouse (Modeling with Linear Systems)
Point-Slope Form of a Line
Solving Equations by Graphing Each Side
Solving Linear Systems (Matrices and Special Solutions)
Solving Linear Systems (Slope-Intercept Form)
Standard Form of a Line

A.REI.12: Graph the solutions to a linear inequality in two variables as a halfplane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Linear Inequalities in Two Variables
Linear Programming
Systems of Linear Inequalities (Slope-intercept form)

F: Functions

F.IF: Interpreting Linear and Exponential Functions

Understand the concept of a linear or exponential function and use function notation. Recognize arithmetic and geometric sequences as examples of linear and exponential functions.

F.IF.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).

Absolute Value with Linear Functions
Exponential Functions
Function Machines 2 (Functions, Tables, and Graphs)
Function Machines 3 (Functions and Problem Solving)
Introduction to Exponential Functions
Introduction to Functions
Linear Functions

Logarithmic Functions
Parabolas
Point-Slope Form of a Line
Points, Lines, and Equations
Quadratics in Factored Form
Quadratics in Polynomial Form
Quadratics in Vertex Form
Radical Functions
Standard Form of a Line

F.IF.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Absolute Value with Linear Functions
Translating and Scaling Functions

Interpret linear or exponential functions that arise in applications in terms of a context.

F.IF.4: 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; and end behavior.

Absolute Value with Linear Functions
Cat and Mouse (Modeling with Linear Systems)
Exponential Functions
Function Machines 3 (Functions and Problem Solving)
General Form of a Rational Function
Graphs of Polynomial Functions
Logarithmic Functions
Points, Lines, and Equations
Quadratics in Factored Form
Quadratics in Polynomial Form
Quadratics in Vertex Form
Radical Functions
Roots of a Quadratic
Slope-Intercept Form of a Line

F.IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

General Form of a Rational Function
Introduction to Functions
Radical Functions
Rational Functions

F.IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Distance-Time Graphs
Distance-Time and Velocity-Time Graphs

Analyze linear or exponential functions using different representations.

F.IF.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F.IF.7.a: Graph linear functions and show intercepts.

Absolute Value with Linear Functions
Cat and Mouse (Modeling with Linear Systems)
Exponential Functions
Graphs of Polynomial Functions
Linear Functions
Point-Slope Form of a Line
Points, Lines, and Equations
Polynomials and Linear Factors
Quadratics in Factored Form
Quadratics in Polynomial Form
Quadratics in Vertex Form

Roots of a Quadratic
Slope-Intercept Form of a Line
Standard Form of a Line
Zap It! Game

F.IF.7.e: Graph exponential functions, showing intercepts and end behavior.

Cosine Function
Exponential Functions
Introduction to Exponential Functions
Logarithmic Functions
Logarithmic Functions: Translating and Scaling
Sine Function
Tangent Function
Translating and Scaling Sine and Cosine Functions

F.IF.9: Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, compare the growth of two linear functions, or two exponential functions such as $y=3^n$ and $y=100\times2^n$.

General Form of a Rational Function
Graphs of Polynomial Functions
Linear Functions
Logarithmic Functions
Quadratics in Polynomial Form
Quadratics in Vertex Form

F.BF: Building Linear or Exponential Functions

Build a linear or exponential function that models a relationship between two quantities.

F.BF.1: Write a function that describes a relationship between two quantities.

F.BF.1.a: Determine an explicit expression, a recursive process, or steps for calculation from a context.

Arithmetic Sequences
Geometric Sequences

Build new functions from existing functions.

F.BF.3: Identify the effect on the graph of replacing f(x) by f(x) + k, for specific values of k (both positive and negative); find the value of k given the graphs. Relate the vertical translation of a linear function to its y-intercept. Experiment with cases and illustrate an explanation of the effects on the graph using technology.

Absolute Value with Linear Functions
Exponential Functions
Introduction to Exponential Functions
Logarithmic Functions
Logarithmic Functions: Translating and Scaling
Quadratics in Vertex Form
Radical Functions
Rational Functions
Translating and Scaling Functions
Translating and Scaling Sine and Cosine Functions
Translations
Zap It! Game

F.LE: Linear and Exponential

Construct and compare linear and exponential models and solve problems.

F.LE.1: Distinguish between situations that can be modeled with linear functions and with exponential functions.

F.LE.1.a: Prove that linear functions grow by equal differences over equal intervals; exponential functions grow by equal factors over equal intervals.

Compound Interest
Direct and Inverse Variation
Exponential Functions
Exponential Growth and Decay

Introduction to Exponential Functions
Linear Functions
Slope-Intercept Form of a Line

F.LE.1.b: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

Arithmetic Sequences
Compound Interest
Distance-Time Graphs
Distance-Time and Velocity-Time Graphs
Linear Functions

F.LE.1.c: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Drug Dosage
Exponential Growth and Decay
Half-life

F.LE.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Compound Interest
Exponential Functions
Exponential Growth and Decay
Point-Slope Form of a Line
Slope-Intercept Form of a Line

F.LE.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly.

Compound Interest
Introduction to Exponential Functions

Interpret expressions for functions in terms of the situation they model.

F.LE.5: Interpret the parameters in a linear or exponential function in terms of a context. Limit exponential functions to those of the form $f(x) = b^x + k$.

Arithmetic Sequences
Compound Interest
Exponential Growth and Decay
Introduction to Exponential Functions

G: Geometry

G.CO: Congruence

Build on student experience with rigid motions from earlier grades.

G.CO.1: Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

Circles
Constructing Congruent Segments and Angles
Constructing Parallel and Perpendicular Lines

G.CO.2: Represent transformations in the plane using, for example, transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

Dilations
Reflections
Rotations, Reflections, and Translations
Translations

G.CO.4: Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

Dilations
Reflections

Rotations, Reflections, and Translations
Translations

G.CO.5: Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, for example, graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. Point out the basis of rigid motions in geometric concepts, for example, translations move points a specified distance along a line parallel to a specified line; rotations move objects along a circular arc with a specified center through a specified angle.

Dilations
Reflections
Rotations, Reflections, and Translations
Similar Figures
Translations

Understand congruence in terms of rigid motions. Rigid motions are at the foundation of the definition of congruence. Reason from the basic properties of rigid motions (that they preserve distance and angle), which are assumed without proof. Rigid motions and their assumed properties can be used to establish the usual triangle congruence criteria, which can then be used to prove other theorems.

G.CO.6: Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide whether they are congruent.

Absolute Value with Linear Functions
Circles
Dilations
Holiday Snowflake Designer
Proving Triangles Congruent
Reflections
Rotations, Reflections, and Translations
Similar Figures
Translations

G.CO.8: Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Proving Triangles Congruent

Make geometric constructions.

G.CO.12: Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Emphasize the ability to formalize and defend how these constructions result in the desired objects.

Constructing Congruent Segments and Angles
Constructing Parallel and Perpendicular Lines
Segment and Angle Bisectors

G.CO.13: Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. Emphasize the ability to formalize and defend how these constructions result in the desired objects.

Concurrent Lines, Medians, and Altitudes
Inscribed Angles

G.GPE: Expressing Geometric Properties With Equations

Use coordinates to prove simple geometric theorems algebraically.

G.GPE.7: Use coordinates to compute perimeters of polygons and areas of triangles and rectangles; e.g., connect with The Pythagorean Theorem and the distance formula.

Circles
Distance Formula

S: Statistics and Probability

S.ID: Interpreting Categorical and Quantitative Data

Summarize, represent, and interpret data on a single count or measurement variable.

S.ID.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).

Box-and-Whisker Plots
Histograms
Mean, Median, and Mode

S.ID.2: Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

Box-and-Whisker Plots
Describing Data Using Statistics
Real-Time Histogram
Sight vs. Sound Reactions

S.ID.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). Calculate the weighted average of a distribution and interpret it as a measure of center.

Box-and-Whisker Plots
Describing Data Using Statistics
Least-Squares Best Fit Lines
Mean, Median, and Mode
Populations and Samples
Reaction Time 1 (Graphs and Statistics)
Reaction Time 2 (Graphs and Statistics)
Real-Time Histogram
Stem-and-Leaf Plots

Summarize, represent, and interpret data on two categorical and quantitative variables.

S.ID.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

S.ID.6.a: Fit a linear function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions, or choose a function suggested by the context. Emphasize linear and exponential models.

Correlation
Least-Squares Best Fit Lines
Solving Using Trend Lines
Trends in Scatter Plots
Zap It! Game

S.ID.6.b: Informally assess the fit of a function by plotting and analyzing residuals. Focus on situations for which linear models are appropriate.

Correlation
Least-Squares Best Fit Lines
Solving Using Trend Lines
Trends in Scatter Plots

S.ID.6.c: Fit a linear function for scatter plots that suggest a linear association.

Correlation
Least-Squares Best Fit Lines
Solving Using Trend Lines
Trends in Scatter Plots

Interpret linear models building on students' work with linear relationships, and introduce the correlation coefficient.

S.ID.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Cat and Mouse (Modeling with Linear Systems)

S.ID.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.

Correlation

Mathematics I Honors

N: Number and Quantity

N.VM: Vector and Matrix Quantities

Represent and model with vector quantities.

N.VM.1: Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).

Adding Vectors
Vectors

N.VM.2: Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

Vectors

N.VM.3: Solve problems involving velocity and other quantities that can be represented by vectors.

2D Collisions
Golf Range

Perform operations on vectors.

N.VM.4: Add and subtract vectors.

N.VM.4.a: Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.

Adding Vectors
Vectors

N.VM.4.b: Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

Adding Vectors
Vectors

N.VM.4.c: Understand vector subtraction v – w as v + (–w), where –w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

Adding Vectors
Vectors

N.VM.5: Multiply a vector by a scalar.

N.VM.5.a: Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx , vy) = (cvx , cvy).

Dilations
Vectors

N.VM.5.b: Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v ≠ 0, the direction of cv is either along v (for c > 0) or against vs (for c < 0).

Vectors

Perform operations on matrices and use matrices in applications.

N.VM.7: Multiply matrices by scalars to produce new matrices, e.g., as when all of the pay-offs in a game are doubled.

Dilations

Mathematics II

SII.MP: Mathematical Practices

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

Biconditional Statements
Conditional Statements

Estimating Population Size
Pattern Flip (Patterns)

SII.MP.1.a: Explain the meaning of a problem and look for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution, plan a solution pathway, and continually monitor progress asking, “Does this make sense?” Consider analogous problems, make connections between multiple representations, identify the correspondence between different approaches, look for trends, and transform algebraic expressions to highlight meaningful mathematics. Check answers to problems using a different method.

Biconditional Statements
Estimating Population Size
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Equations
Using Algebraic Expressions

SII.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

SII.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

SII.MP.3.a: Understand and use stated assumptions, definitions, and previously established results in constructing arguments. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. Justify conclusions and communicate them to others. Respond to the arguments of others by listening, asking clarifying questions, and critiquing the reasoning of others.

Biconditional Statements
Conditional Statements

SII.MP.4: Model with mathematics.

Estimating Sums and Differences

SII.MP.4.a: Apply mathematics to solve problems arising in everyday life, society, and the workplace. Make assumptions and approximations, identifying important quantities to construct a mathematical model. Routinely interpret mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

Determining a Spring Constant
Estimating Population Size

SII.MP.5: Use appropriate tools strategically.

Elapsed Time

SII.MP.5.a: Consider the available tools and be sufficiently familiar with them to make sound decisions about when each tool might be helpful, recognizing both the insight to be gained as well as the limitations. Identify relevant external mathematical resources and use them to pose or solve problems. Use tools to explore and deepen their understanding of concepts.

Segment and Angle Bisectors

SII.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

SII.MP.6.a: Communicate precisely to others. Use explicit definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose. Specify units of measure and label axes to clarify the correspondence with quantities in a problem. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

SII.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

SII.MP.7.a: Look closely at mathematical relationships to identify the underlying structure by recognizing a simple structure within a more complicated structure. See complicated things, such as some algebraic expressions, as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

SII.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

SII.MP.8.a: Notice if reasoning is repeated, and look for both generalizations and shortcuts. Evaluate the reasonableness of intermediate results by maintaining oversight of the process while attending to the details.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

N: Number and Quantity

N.RN: The Real Number System

Extend the properties of exponents to rational exponents.

N.RN.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.

Exponents and Power Rules

Use properties of rational and irrational numbers.

N.RN.3: Explain why sums and products of rational numbers are rational, that the sum of a rational number and an irrational number is irrational, and that the product of a nonzero rational number and an irrational number is irrational. Connect to physical situations (e.g., finding the perimeter of a square of area 2).

Circumference and Area of Circles
Estimating Population Size

N.CN: The Complex Number System

Perform arithmetic operations with complex numbers.

N.CN.1: Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real.

Points in the Complex Plane
Roots of a Quadratic

N.CN.2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. Limit to multiplications that involve i^2 as the highest power of i.

Points in the Complex Plane

Use complex numbers in polynomial identities and equations.

N.CN.7: Solve quadratic equations with real coefficients that have complex solutions.

Roots of a Quadratic

A: Algebra

A.SSE: Seeing Structure in Expression

Interpret the structure of expressions.

A.SSE.1: Interpret quadratic and exponential expressions that represent a quantity in terms of its context.

A.SSE.1.a: Interpret parts of an expression, such as terms, factors, and coefficients.

Compound Interest
Exponential Growth and Decay
Unit Conversions

A.SSE.1.b: Interpret increasingly more complex expressions by viewing one or more of their parts as a single entity. Exponents are extended from the integer exponents to rational exponents focusing on those that represent square or cube roots.

Compound Interest
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II
Translating and Scaling Functions
Using Algebraic Expressions

A.SSE.2: Use the structure of an expression to identify ways to rewrite it.

Equivalent Algebraic Expressions II
Factoring Special Products
Modeling the Factorization of ax^2+bx+c
Modeling the Factorization of x^2+bx+c
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II
Solving Algebraic Equations II

Write expressions in equivalent forms to solve problems, balancing conceptual understanding and procedural fluency in work with equivalent expressions.

A.SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. For example, development of skill in factoring and completing the square goes hand in hand with understanding what different forms of a quadratic expression reveal.

A.SSE.3.a: Factor a quadratic expression to reveal the zeros of the function it defines.

Factoring Special Products
Modeling the Factorization of ax^2+bx+c
Modeling the Factorization of x^2+bx+c

A.SSE.3.c: Use the properties of exponents to transform expressions for exponential functions.

Exponents and Power Rules

A.APR: Arithmetic With Polynomials and Rational Expressions

Perform arithmetic operations on polynomials. Focus on polynomial expressions that simplify to forms that are linear or quadratic in a positive integer power of x.

A.APR.1: Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Addition of Polynomials

A.CED: Creating Equations

Create equations that describe numbers or relationships. Extend work on linear and exponential equations to quadratic equations.

A.CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

Absolute Value Equations and Inequalities
Arithmetic Sequences
Compound Interest
Exploring Linear Inequalities in One Variable
Geometric Sequences
Linear Inequalities in Two Variables
Modeling One-Step Equations
Modeling and Solving Two-Step Equations
Quadratic Inequalities
Solving Equations on the Number Line
Solving Linear Inequalities in One Variable
Solving Two-Step Equations
Using Algebraic Equations

A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

2D Collisions
Air Track
Compound Interest
Determining a Spring Constant
Golf Range
Points, Lines, and Equations
Slope-Intercept Form of a Line

A.CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations; extend to formulas involving squared variables.

Area of Triangles
Solving Formulas for any Variable

A.REI: Reasoning With Equations and Inequalities

Solve equations and inequalities in one variable.

A.REI.4: Solve quadratic equations in one variable.

A.REI.4.a: Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

Roots of a Quadratic

A.REI.4.b: Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.

Factoring Special Products
Modeling the Factorization of ax^2+bx+c
Modeling the Factorization of x^2+bx+c
Points in the Complex Plane
Roots of a Quadratic

F: Functions

F.IF: Interpret Functions

Interpret quadratic functions that arise in applications in terms of a context.

F.IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. Focus on quadratic functions; compare with linear and exponential functions.

Exponential Functions
General Form of a Rational Function
Introduction to Functions
Logarithmic Functions
Radical Functions
Rational Functions

F.IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Distance-Time Graphs
Distance-Time and Velocity-Time Graphs

Analyze functions using different representations.

F.IF.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F.IF.7.a: Graph linear and quadratic functions and show intercepts, maxima, and minima.

Linear Functions
Points, Lines, and Equations
Quadratics in Factored Form
Quadratics in Polynomial Form
Quadratics in Vertex Form
Slope-Intercept Form of a Line
Zap It! Game

F.IF.7.b: Graph piecewise-defined functions and absolute value functions. Compare and contrast absolute value and piecewise-defined functions with linear, quadratic, and exponential functions. Highlight issues of domain, range, and usefulness when examining piecewise-defined functions.

Absolute Value with Linear Functions
Radical Functions
Translating and Scaling Functions

F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

F.IF.8.a: Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Factoring Special Products
Modeling the Factorization of ax^2+bx+c
Modeling the Factorization of x^2+bx+c

F.IF.8.b: Use the properties of exponents to interpret expressions for exponential functions.

Compound Interest
Exponential Growth and Decay

F.IF.9: Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Extend work with quadratics to include the relationship between coefficients and roots, and that once roots are known, a quadratic equation can be factored.

General Form of a Rational Function
Graphs of Polynomial Functions
Linear Functions
Logarithmic Functions
Modeling the Factorization of x^2+bx+c
Quadratics in Factored Form
Quadratics in Polynomial Form
Quadratics in Vertex Form
Roots of a Quadratic
Zap It! Game

F.BF: Building Functions

Build a function that models a relationship between two quantities.

F.BF.1: Write a quadratic or exponential function that describes a relationship between two quantities.

F.BF.1.a: Determine an explicit expression, a recursive process, or steps for calculation from a context.

Arithmetic Sequences
Geometric Sequences

F.BF.1.b: Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

Addition and Subtraction of Functions

Build new functions from existing functions.

F.BF.3: Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Focus on quadratic functions and consider including absolute value functions. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Absolute Value with Linear Functions
Exponential Functions
Introduction to Exponential Functions
Logarithmic Functions
Logarithmic Functions: Translating and Scaling
Quadratics in Vertex Form
Radical Functions
Rational Functions
Translating and Scaling Functions
Translating and Scaling Sine and Cosine Functions
Translations
Zap It! Game

F.LE: Linear, Quadratic, and Exponential Models

Construct and compare linear, quadratic, and exponential models and solve problems.

F.LE.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. Compare linear and exponential growth to quadratic growth.

Compound Interest
Exponential Functions
Introduction to Exponential Functions

F.TF: Trigonometric Functions

Prove and apply trigonometric identities. Limit θ to angles between 0 and 90 degrees. Connect with the Pythagorean Theorem and the distance formula.

F.TF.8: Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find sin (θ), cos (θ), or tan (θ), given sin (θ), cos (θ), or tan (θ), and the quadrant of the angle.

Simplifying Trigonometric Expressions
Sine, Cosine, and Tangent Ratios

G: Geometry

G.CO: Congruence

Prove geometric theorems. Encourage multiple ways of writing proofs, such as narrative paragraphs, flow diagrams, two-column format, and diagrams without words. Focus on the validity of the underlying reasoning while exploring a variety of formats for expressing that reasoning.

G.CO.9: Prove theorems about lines and angles.

Investigating Angle Theorems

G.CO.10: Prove theorems about triangles.

Pythagorean Theorem
Triangle Angle Sum
Triangle Inequalities

G.CO.11: Prove theorems about parallelograms.

Parallelogram Conditions
Special Parallelograms

G.SRT: Similarity, Right Triangles, and Trigonometry

Understand similarity in terms of similarity transformations.

G.SRT.1: Verify experimentally the properties of dilations given by a center and a scale factor.

G.SRT.1.b: The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

Dilations
Similar Figures

G.SRT.2: Given two figures, use the definition of similarity in terms of similarity transformations to decide whether they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

Circles
Dilations
Similar Figures
Similarity in Right Triangles

Prove theorems involving similarity.

G.SRT.4: Prove theorems about triangles.

Pythagorean Theorem
Similar Figures

G.SRT.5: Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Dilations
Perimeters and Areas of Similar Figures
Similarity in Right Triangles

Define trigonometric ratios and solve problems involving right triangles.

G.SRT.6: Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

Sine, Cosine, and Tangent Ratios

G.SRT.8: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Distance Formula
Pythagorean Theorem
Pythagorean Theorem with a Geoboard
Sine, Cosine, and Tangent Ratios

G.C: Circles

Understand and apply theorems about circles.

G.C.2: Identify and describe relationships among inscribed angles, radii, and chords.

Inscribed Angles

Find arc lengths and areas of sectors of circles. Use this as a basis for introducing the radian as a unit of measure. It is not intended that it be applied to the development of circular trigonometry in this course.

G.C.5: Derive, using similarity, the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Chords and Arcs

G.GPE: Expressing Geometric Properties With Equations

Translate between the geometric description and the equation for a conic section.

G.GPE.1: Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Circles
Distance Formula
Pythagorean Theorem
Pythagorean Theorem with a Geoboard

G.GMD: Geometric Measurement and Dimension

Explain volume formulas and use them to solve problems.

G.GMD.1: Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Informal arguments for area formulas can make use of the way in which area scale under similarity transformations: when one figure in the plane results from another by applying a similarity transformation with scale factor k, its area is k^2 times the area of the first. Use dissection arguments, Cavalieri's principle, and informal limit arguments.

Circumference and Area of Circles
Prisms and Cylinders
Pyramids and Cones

G.GMD.3: Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. Informal arguments for volume formulas can make use of the way in which volume scale under similarity transformations: when one figure results from another by applying a similarity transformation, volumes of solid figures scale by k^3 under a similarity transformation with scale factor k.

Prisms and Cylinders
Pyramids and Cones

S: Statistics

S.ID: Interpreting Categorical and Quantitative Data

Summarize, represent, and interpret data on two categorical or quantitative variables.

S.ID.5: Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and condition reltive frequencies). Recognize possible associations and trends in the date.

Histograms

S.CP: Conditional Probability and the Rules of Probability

Understand independence and conditional probability and use them to interpret data.

S.CP.1: Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").

Independent and Dependent Events
Probability Simulations
Theoretical and Experimental Probability

Use the rules of probability to compute probabilities of compound events in a uniform probability model.

S.CP.6: Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.

Independent and Dependent Events

Mathematics II Honors

N: Number and Quantity

N.CN: Complex Number System

Perform arithmetic operations with complex numbers.

N.CN.3: Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

Points in the Complex Plane

Represent complex numbers and their operations on the complex plane.

N.CN.4: Represent complex numbers on the complex plane in rectangular form, and explain why the rectangular form of a given complex number represents the same number.

Points in the Complex Plane

N.CN.5: Represent addition, subtraction, and multiplication geometrically on the complex plane; use properties of this representation for computation.

Points in the Complex Plane

A: Algebra

A.REI: Reasoning With Equations and Inequalities

Solve systems of equations.

A.REI.8: Represent a system of linear equations as a single-matrix equation in a vector variable.

Solving Linear Systems (Matrices and Special Solutions)

A.REI.9: Find the inverse of a matrix if it exists, and use it to solve systems of linear equations (using technology for matrices of dimension 3 x 3 or greater).

Solving Linear Systems (Matrices and Special Solutions)

F: Functions

F.IF: Interpreting Functions

Analyze functions using different representations.

F.IF.11: Represent series algebraically, graphically, and numerically.

Arithmetic Sequences
Geometric Sequences

G: Geometry

G-GPE: Expressing Geometric Properties With Equations

Translate between the geometric description and the equation for a conic section.

G.GPE.2: Derive the equation of a parabola given a focus and directrix.

Parabolas

G.GPE.3: Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.

Ellipses
Hyperbolas

S: Statistics and Probability

S.CP: Conditional Probability and the Rules of Probability

Understand independence and conditional probability and use them to interpret data.

S.CP.2: Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

Independent and Dependent Events

S.CP.3: Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of B given A is the same as the probability of B.

Independent and Dependent Events

Use the rules of probability to compute probabilities of compound events in a uniform probability model.

S.CP.8: Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.

Independent and Dependent Events

Mathematics III

SIII.MP: Mathematical Practices

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

Biconditional Statements
Conditional Statements
Estimating Population Size
Pattern Flip (Patterns)

SIII.MP.1.a: Explain the meaning of a problem and look for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution, plan a solution pathway, and continually monitor progress asking, “Does this make sense?” Consider analogous problems, make connections between multiple representations, identify the correspondence between different approaches, look for trends, and transform algebraic expressions to highlight meaningful mathematics. Check answers to problems using a different method.

Biconditional Statements
Estimating Population Size
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Equations
Using Algebraic Expressions

SIII.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

SIII.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

SIII.MP.3.a: Understand and use stated assumptions, definitions, and previously established results in constructing arguments. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. Justify conclusions and communicate them to others. Respond to the arguments of others by listening, asking clarifying questions, and critiquing the reasoning of others.

Biconditional Statements
Conditional Statements

SIII.MP.4: Model with mathematics.

Estimating Sums and Differences

SIII.MP.4.a: Apply mathematics to solve problems arising in everyday life, society, and the workplace. Make assumptions and approximations, identifying important quantities to construct a mathematical model. Routinely interpret mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

Determining a Spring Constant
Estimating Population Size

SIII.MP.5: Use appropriate tools strategically.

Elapsed Time

SIII.MP.5.a: Consider the available tools and be sufficiently familiar with them to make sound decisions about when each tool might be helpful, recognizing both the insight to be gained as well as the limitations. Identify relevant external mathematical resources and use them to pose or solve problems. Use tools to explore and deepen their understanding of concepts.

Segment and Angle Bisectors

SIII.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

SIII.MP.6.a: Communicate precisely to others. Use explicit definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose. Specify units of measure and label axes to clarify the correspondence with quantities in a problem. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

SIII.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

SIII.MP.7.a: Look closely at mathematical relationships to identify the underlying structure by recognizing a simple structure within a more complicated structure. See complicated things, such as some algebraic expressions, as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

SIII.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

SIII.MP.8.a: Notice if reasoning is repeated, and look for both generalizations and shortcuts. Evaluate the reasonableness of intermediate results by maintaining oversight of the process while attending to the details.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

A: Algebra

A.SSE: Seeing Structures in Expressions

Interpret the structure of expressions. Extend to polynomial and rational expressions

A.SSE.1: Interpret polynomial and rational expressions that represent a quantity in terms of its context.

A.SSE.1.a: Interpret parts of an expression, such as terms, factors, and coefficients.

Compound Interest
Exponential Growth and Decay
Unit Conversions

A.SSE.1.b: Interpret complex expressions by viewing one or more of their parts as a single entity. For example, examine the behavior of P(1+r/n) to the nt power as n becomes large.

Compound Interest
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II
Translating and Scaling Functions
Using Algebraic Expressions

A.SSE.2: Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

Dividing Exponential Expressions
Equivalent Algebraic Expressions I
Equivalent Algebraic Expressions II
Exponents and Power Rules
Factoring Special Products
Modeling the Factorization of ax^2+bx+c
Modeling the Factorization of x^2+bx+c
Multiplying Exponential Expressions
Simplifying Algebraic Expressions I
Simplifying Algebraic Expressions II
Simplifying Trigonometric Expressions
Solving Algebraic Equations II
Using Algebraic Expressions

A.APR: Arithmetic With Polynomials and Rational Expressions

Perform arithmetic operations on polynomials, extending beyond the quadratic polynomials.

A.APR.1: Understand that all polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Addition and Subtraction of Functions
Addition of Polynomials
Modeling the Factorization of x^2+bx+c

Understand the relationship between zeros and factors of polynomials.

A.APR.2: Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).

Dividing Polynomials Using Synthetic Division
Polynomials and Linear Factors

A.APR.3: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Polynomials and Linear Factors
Quadratics in Factored Form

Use polynomial identities to solve problems.

A.APR.5: Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers.

Binomial Probabilities

A.CED: Creating Equations

Create equations that describe numbers or relationships, using all available types of functions to create such equations.

A.CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

Absolute Value Equations and Inequalities
Absolute Value with Linear Functions
Arithmetic Sequences
Compound Interest
Exploring Linear Inequalities in One Variable
Exponential Functions
General Form of a Rational Function
Geometric Sequences
Introduction to Exponential Functions
Linear Functions
Linear Inequalities in Two Variables
Logarithmic Functions
Modeling One-Step Equations
Modeling and Solving Two-Step Equations
Quadratic Inequalities
Quadratics in Factored Form
Quadratics in Polynomial Form
Quadratics in Vertex Form
Rational Functions
Slope-Intercept Form of a Line
Solving Equations on the Number Line
Solving Linear Inequalities in One Variable
Solving Two-Step Equations
Translating and Scaling Functions
Using Algebraic Equations

A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

2D Collisions
Air Track
Compound Interest
Determining a Spring Constant
Golf Range
Points, Lines, and Equations
Slope-Intercept Form of a Line

A.CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.

Linear Programming

A.CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Solving Formulas for any Variable

A.REI: Reasoning with Equations and Inequalities

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

A.REI.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Radical Functions

Represent and solve equations and inequalities graphically.

A.REI.11: Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, for example, using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/ or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Cat and Mouse (Modeling with Linear Systems)
Point-Slope Form of a Line
Solving Equations by Graphing Each Side
Solving Linear Systems (Matrices and Special Solutions)
Solving Linear Systems (Slope-Intercept Form)
Standard Form of a Line

F: Functions

F.IF: Interpreting Functions

Interpret functions that arise in applications in terms of a context.

F.IF.4: 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.

Absolute Value with Linear Functions
Cat and Mouse (Modeling with Linear Systems)
Exponential Functions
Function Machines 3 (Functions and Problem Solving)
General Form of a Rational Function
Graphs of Polynomial Functions
Logarithmic Functions
Points, Lines, and Equations
Quadratics in Factored Form
Quadratics in Polynomial Form
Quadratics in Vertex Form
Radical Functions
Roots of a Quadratic
Slope-Intercept Form of a Line
Translating and Scaling Sine and Cosine Functions

F.IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

General Form of a Rational Function
Introduction to Functions
Radical Functions
Rational Functions

F.IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Distance-Time Graphs
Distance-Time and Velocity-Time Graphs

Analyze functions using different representations.

F.IF.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F.IF.7.b: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. Compare and contrast square root, cubed root, and step functions with all other functions.

Absolute Value with Linear Functions
Radical Functions
Translating and Scaling Functions

F.IF.7.c: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

Graphs of Polynomial Functions
Polynomials and Linear Factors
Quadratics in Factored Form
Quadratics in Vertex Form
Roots of a Quadratic
Zap It! Game

F.IF.7.d: Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

General Form of a Rational Function
Rational Functions

F.IF.7.e: Graph exponential and logarithmic functions, showing intercepts and end behavior; and trigonometric functions, showing period, midline, and amplitude.

Cosine Function
Exponential Functions
Introduction to Exponential Functions
Logarithmic Functions
Logarithmic Functions: Translating and Scaling
Sine Function
Tangent Function
Translating and Scaling Sine and Cosine Functions

F.BF: Building Functions

Build new functions from existing functions.

F.BF.3: Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs.

Absolute Value with Linear Functions
Exponential Functions
Introduction to Exponential Functions
Logarithmic Functions
Logarithmic Functions: Translating and Scaling
Quadratics in Vertex Form
Radical Functions
Rational Functions
Translating and Scaling Functions
Translating and Scaling Sine and Cosine Functions
Translations
Zap It! Game

F.LE: Linear, Quadratic, and Exponential Models

Construct and compare linear, quadratic, and exponential models and solve problems.

F.LE.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quanitity increasing linearly, quadratically, or (more generally) as a polynomial function.

Compound Interest
Introduction to Exponential Functions

F.LE.4: For exponential models, express as a logarithm the solution to ab to the ct power = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology. Include the relationship between properties of logarithms and properties of exponents, such as the connection between the properties of exponents and the basic logarithm property that log xy = log x + log y.

Compound Interest
Logarithmic Functions

Interpret expressions for functions in terms of the situation it models. Introduce f(x) = ex as a model for continuous growth

F.LE.5: Interpret the parameters in a linear, quadratic, and exponential functions in terms of a context.

Arithmetic Sequences
Compound Interest
Exponential Growth and Decay
Introduction to Exponential Functions

F.TF: Trigonometric Functions

Extend the domain of trigonometric functions using the unit circle.

F.TF.3: Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π6, and use the unit circle to express the values of sine, cosine, and tangent for π – x, π + x, and 2π – x in terms of their values for x, where x is any real number.

Cosine Function
Sine Function
Sum and Difference Identities for Sine and Cosine
Tangent Function
Translating and Scaling Sine and Cosine Functions

Model periodic phenomena with trigonometric functions.

F.TF.5: Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

Sound Beats and Sine Waves

S: Statistics

S.IC: Making Inferences and Justifying Conclusions

Understand and evaluate random processes underlying statistical experiments.

S.IC.1: Understand that statistics allow inferences to be made about population parameters based on a random sample from that population.

Polling: City
Polling: Neighborhood
Populations and Samples

Draw and justify conclusions from sample surveys, experiments, and observational studies. In earlier grades, students are introduced to different ways of collecting data and use graphical displays and summary statistics to make comparisons. These ideas are revisited with a focus on how the way in which data is collected determines the scope and nature of the conclusions that can be drawn from that data. The concept of statistical significance is developed informally through simulation as meaning a result that is unlikely to have occurred solely as a result of random selection in sampling or random assignment in an experiment. For S.IC.4, focus on the variability of results from experiments—that is, focus on statistics as a way of dealing with, not eliminating, inherent randomness.

S.IC.4: Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.

Estimating Population Size
Polling: City
Polling: Neighborhood

Mathematics III Honors

N: Number and Quantity

N.CN: Complex Number System

Perform arithmetic operations with complex numbers.

N.CN.3: Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

Points in the Complex Plane

Represent complex numbers and their operations on the complex plane.

N.CN.4: Represent complex numbers on the complex plane in rectangular form and polar form (including real and imaginary numbers), and explain why the rectangular form of a given complex number represents the same number.

Points in the Complex Plane

Use complex numbers in polynomial identities and equations.

N.CN.10: Multiply complex numbers in polar form and use DeMoivre's Theorem to find roots of complex numbers.

Points in the Complex Plane

F: Functions

F.IF: Interpreting Functions

Analyze functions using different representations.

F.IF.7: Graph functions expressed symbolically, and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F.IF.7.d: Graph rational functions, identifying zeros, asymptotes, and point discontinuities when suitable factorizations are available, and showing end behavior.

General Form of a Rational Function
Rational Functions

F.BF: Building Functions

Build new functions from existing functions.

F.BF.4: Find inverse functions.

F.BF.4.b: Verify by composition that one function is the inverse of another.

Logarithmic Functions

F.BF.4.c: Read values of an inverse function from a graph or a table, given that the function has an inverse.

Logarithmic Functions

F.BF.5: Understand the inverse relationship between exponents and logarithms, and use this relationship to solve problems involving logarithms and exponents.

Logarithmic Functions

F.TF: Trigonometric Functions

Prove and apply trigonometric identities.

F.TF.9: Prove the addition and subtraction formulas for sine, cosine, and tangent, and use them to solve problems.

Simplifying Trigonometric Expressions
Sum and Difference Identities for Sine and Cosine

S: Statistics and Probability

S.CP: Conditional Probability and the Rules of Probability

Use the rules of probability to compute probabilities of compound events in a uniform probability model.

S.CP.9: Use permutations and combinations to compute probabilities of compound events and solve problems.

Binomial Probabilities
Permutations and Combinations

Pre-Calculus

P.MP: Mathematical Practices

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

Biconditional Statements
Conditional Statements
Estimating Population Size
Pattern Flip (Patterns)

P.MP.1.a: Explain the meaning of a problem and look for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution, plan a solution pathway, and

continually monitor progress asking, “Does this make sense?” Consider analogous problems, make connections between multiple representations, identify the correspondence between different approaches, look for trends, and transform algebraic expressions to highlight meaningful mathematics. Check answers to problems using a different method.

Biconditional Statements
Estimating Population Size
Fraction, Decimal, Percent (Area and Grid Models)
Improper Fractions and Mixed Numbers
Linear Inequalities in Two Variables
Modeling One-Step Equations
Multiplying with Decimals
Pattern Flip (Patterns)
Polling: City
Solving Equations on the Number Line
Using Algebraic Equations
Using Algebraic Expressions

P.MP.2: Reason abstractly and quantitatively.

Conditional Statements
Estimating Population Size

P.MP.3: Construct viable arguments and critique the reasoning of others.

Biconditional Statements

P.MP.3.a: Understand and use stated assumptions, definitions, and previously established results in constructing arguments. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. Justify conclusions and communicate them to others. Respond to the arguments of others by listening, asking clarifying questions, and critiquing the reasoning of others.

Biconditional Statements
Conditional Statements

P.MP.4: Model with mathematics.

Estimating Sums and Differences

P.MP.4.a: Apply mathematics to solve problems arising in everyday life, society, and the workplace. Make assumptions and approximations, identifying important quantities to construct a mathematical model. Routinely interpret mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

Determining a Spring Constant
Estimating Population Size

P.MP.5: Use appropriate tools strategically.

Elapsed Time

P.MP.5.a: Consider the available tools and be sufficiently familiar with them to make sound decisions about when each tool might be helpful, recognizing both the insight to be gained as well as the limitations. Identify relevant external mathematical resources and use them to pose or solve problems. Use tools to explore and deepen their understanding of concepts.

Segment and Angle Bisectors

P.MP.6: Attend to precision.

Biconditional Statements
Fraction, Decimal, Percent (Area and Grid Models)
Using Algebraic Expressions

P.MP.6.a: Communicate precisely to others. Use explicit definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose. Specify units of measure and label axes to clarify the correspondence with quantities in a problem. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.

Arithmetic Sequences
Finding Patterns
Fraction, Decimal, Percent (Area and Grid Models)
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

P.MP.7: Look for and make use of structure.

Pattern Flip (Patterns)

P.MP.7.a: Look closely at mathematical relationships to identify the underlying structure by recognizing a simple structure within a more complicated structure. See complicated things, such as some algebraic expressions, as single objects or as being composed of several objects.

Arithmetic Sequences
Finding Patterns
Function Machines 2 (Functions, Tables, and Graphs)
Geometric Sequences
Pattern Flip (Patterns)

P.MP.8: Look for and express regularity in repeated reasoning.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Finding Patterns
Geometric Sequences
Pattern Finder
Pattern Flip (Patterns)

P.MP.8.a: Notice if reasoning is repeated, and look for both generalizations and shortcuts. Evaluate the reasonableness of intermediate results by maintaining oversight of the process while attending to the details.

Arithmetic Sequences
Arithmetic and Geometric Sequences
Geometric Sequences

N: Number and Quantity

N.VM: Vector and Matrix Quantities

Represent and model with vector quantities.

N.VM.1: Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).

Adding Vectors
Vectors

N.VM.2: Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

Vectors

N.VM.3: Solve problems involving velocity and other quantities that can be represented by vectors.

2D Collisions
Golf Range

Perform operations on vectors.

N.VM. 4: Add and subtract vectors.

N.VM. 4.a: Add vectors end to end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.

Adding Vectors
Vectors

N.VM. 4.b: Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

Adding Vectors
Vectors

N.VM. 4.c: Understand vector subtraction v – w as v + (–w), where –w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

Adding Vectors
Vectors

N.VM.5: Multiply a vector by a scalar.

N.VM.5.a: Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx , vy) = (cvx, cvy).

Dilations
Vectors

N.VM.5.b: Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v ≠ 0, the direction of cv is either along v (for c > 0) or against vs (for c < 0).

Vectors

N.CN: Complex Number Systems

Perform arithmetic operations with complex numbers.

N.CN.3: Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

Points in the Complex Plane

Represent complex numbers and their operations on the complex plane.

N.CN.4: Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.

Points in the Complex Plane

Use complex numbers in polynomial identities and equations.

N.CN.10: Multiply complex numbers in polar form and use DeMoivre's Theorem to find roots of complex numbers.

Points in the Complex Plane

A: Algebra

A.REI: Reasoning with Equations and Inequalities

Solve systems of equations.

A.REI.8.: Represent a system of linear equations as a single matrix equation in a vector variable.

Solving Linear Systems (Matrices and Special Solutions)

A.REI.9.: Find the inverse of a matrix, if it exists, and use it to solve systems of linear equations (using technology for matrices of dimension 3 x 3 or greater).

Solving Linear Systems (Matrices and Special Solutions)

F: Functions

F.IF: Interpreting Functions

Analyze functions using different representations.

F.IF.7: Graph functions expressed symbolically, and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F.IF.7.d: Graph rational functions, identifying zeros, asymptotes, and point discontinuities when suitable factorizations are available, and showing end behavior.

General Form of a Rational Function
Rational Functions

F.IF.11: Represent series algebraically, graphically, and numerically.

Arithmetic Sequences
Geometric Sequences

F.BF: Building Functions

Build new functions from existing functions.

F.BF.4: Find inverse functions.

F.BF.4.b: Verify by composition that one function is the inverse of another.

Logarithmic Functions

F.BF.4.c: Read values of an inverse function from a graph or a table, given that the function has an inverse.

Logarithmic Functions

F.BF.5: Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Logarithmic Functions

F.TF: Trigonometric Functions

Prove and apply trigonometric identities.

F.TF.9: Prove the addition and subtraction formulas for sine, cosine, and tangent, and use them to solve problems.

Simplifying Trigonometric Expressions
Sum and Difference Identities for Sine and Cosine

G: Geometry

G.GPE: Expressing Geometric Properties With Equations

Translate between the geometric description and the equation for a conic section.

G.GPE.2: Derive the equation of a parabola given a focus and a directrix.

Parabolas

G.GPE.3: Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.

Ellipses
Hyperbolas

S: Statistics

S.CP: Conditional Probability and the Rules of Probability

Understand independence and conditional probability and use them to interpret data.

S.CP.2: Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

Independent and Dependent Events

S.CP.3: Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of B given A is the same as the probability of B.

Independent and Dependent Events

Use the rules of probability to compute probabilities of compound events in a uniform probability model.

S.CP.8: Apply the general Multiplication Rule in a uniform probability model, P(A andB) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.

Independent and Dependent Events

S.CP.9: Use permutations and combinations to compute probabilities of compound events and solve problems.

Binomial Probabilities
Permutations and Combinations

ExploreLearning Gizmos®

Correlations for Utah Science with Engineering Education (SEEd) Standards

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Third Grade

3.1: Weather and Climate Patterns

3.1.1: Analyze and interpret data to reveal patterns that indicate typical weather conditions expected during a particular season. Emphasize students gathering data in a variety of ways and representing data in tables and graphs. Examples of data could include temperature, precipitation, or wind speed.

Comparing Climates (Customary)
Comparing Climates (Metric)
Observing Weather (Customary)
Observing Weather (Metric)

3.1.2: Obtain and communicate information to describe climate patterns in different regions of the world. Emphasize how climate patterns can be used to predict typical weather conditions. Examples of climate patterns could be average seasonal temperature and average seasonal precipitation.

Comparing Climates (Customary)
Comparing Climates (Metric)

3.1.3: Design a solution that reduces the effects of a weather-related hazard. Define the problem, identify criteria and constraints, develop possible solutions, analyze data from testing solutions, and propose modifications for optimizing a solution. Examples could include barriers to prevent flooding or wind-resistant roofs.

Flood and Storm-Proof Homes

3.2: Effects of Traits on Survival

3.2.1: Develop and use models to describe changes that organisms go through during their life cycles. Emphasize that organisms have unique and diverse life cycles but follow a pattern of birth, growth, reproduction, and death. Examples of changes in life cycles could include how some plants and animals look different at different stages of life or how other plants and animals only appear to change size in their life.

Honeybee Hive

3.2.2: Analyze and interpret data to identify patterns of traits that plants and animals have inherited from parents. Emphasize the similarities and differences in traits between parent organisms and offspring and variation of traits in groups of similar organisms.

Inheritance

3.2.3: Construct an explanation that the environment can affect the traits of an organism. Examples could include that the growth of normally tall plants is stunted with insufficient water or that pets given too much food and little exercise may become overweight.

Effect of Environment on New Life Form
Growing Plants
Inheritance
Measuring Trees

3.2.4: Construct an explanation showing how variations in traits and behaviors can affect the ability of an individual to survive and reproduce. Examples of traits could include large thorns protecting a plant from being eaten or strong smelling flowers to attracting certain pollinators. Examples of behaviors could include animals living in groups for protection or migrating to find more food.

Natural Selection

3.2.5: Engage in argument from evidence that in a particular habitat (system) some organisms can survive well, some survive less well, and some cannot survive at all. Emphasize that organisms and habitats form systems in which the parts depend upon each other. Examples of evidence could include needs and characteristics of the organisms and habitats involved such as cacti growing in dry, sandy soil but not surviving in wet, saturated soil.

Comparing Climates (Customary)
Comparing Climates (Metric)

3.3: Force Affects Motion

3.3.2: Analyze and interpret data from observations and measurements of an object's motion to identify patterns in its motion that can be used to predict future motion. Examples of motion with a predictable pattern could include a child swinging on a swing or a ball rolling down a ramp.

Measuring Motion

3.3.4: Ask questions to plan and carry out an investigation to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Emphasize how static electricity and magnets can cause objects to move without touching. Examples could include the force an electrically charged balloon has on hair, how magnet orientation affects the direction of a force, or how distance between objects affects the strength of a force. Electrical charges and magnetic fields will be taught in Grades 6 through 8.

Charge Launcher
Magnetism

Fourth Grade

4.1: Organisms Functioning in Their Environment

4.1.1: Construct an explanation from evidence that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. Emphasize how structures support an organism's survival in its environment and how internal and external structures of plants and animals vary within the same and across multiple Utah environments. Examples of structures could include thorns on a stem to prevent predation or gills on a fish to allow it to breathe underwater.

Circulatory System
Comparing Climates (Customary)
Comparing Climates (Metric)
Digestive System
Flower Pollination
Honeybee Hive
Senses
Animal Group Behavior

4.1.2: Develop and use a model of a system to describe how animals receive different types of information from their environment through their senses, process the information in their brain, and respond to the information. Emphasize how animals are able to use their perceptions and memories to guide their actions. Examples could include models that explain how animals sense and then respond to different aspects of their environment such as sounds, temperature, or smell.

Eyes and Vision 2 - Focusing Light
Eyes and Vision 3 - Sensing Light
Honeybee Hive
Senses
Animal Group Behavior

4.1.3: Analyze and interpret data from fossils to provide evidence of the stability and change in organisms and environments from long ago. Emphasize using the structures of fossils to make inferences about ancient organisms. Examples of fossils and environments could include comparing a trilobite with a horseshoe crab in an ocean environment or using a fossil footprint to determine the size of a dinosaur.

Building Pangaea

4.1.4: Engage in argument from evidence based on patterns in rock layers and fossils found in those layers to support an explanation that environments have changed over time. Emphasize the relationship between fossils and past environments. Examples could include tropical plant fossils found in Arctic areas and rock layers with marine shell fossils found above rock layers with land plant fossils.

Erosion Rates
River Erosion
Weathering

4.2: Energy Transfer

4.2.1: Construct an explanation to describe the cause and effect relationship between the speed of an object and the energy of that object. Emphasize using qualitative descriptions of the relationship between speed and energy like fast, slow, strong, or weak. An example could include a ball that is kicked hard has more energy and travels a greater distance than a ball that is kicked softly.

Sled Wars

4.2.2: Ask questions and make observations about the changes in energy that occur when objects collide. Emphasize that energy is transferred when objects collide and may be converted to different forms of energy. Examples could include changes in speed when one moving ball collides with another or the transfer of energy when a toy car hits a wall.

Sled Wars

4.2.3: Plan and carry out an investigation to gather evidence from observations that energy can be transferred from place to place by sound, light, heat, and electrical currents. Examples could include sound causing objects to vibrate and electric currents being used to produce motion or light.

Circuit Builder
Conduction and Convection

Energy Conversions
Heat Absorption

4.2.4: Design a device that converts energy from one form to another. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution. Emphasize identifying the initial and final forms of energy. Examples could include solar ovens that convert light energy to heat energy or a simple alarm system that converts motion energy into sound energy.

Circuit Builder
Energy Conversions

4.3: Wave Patterns

4.3.1: Develop and use a model to describe the regular patterns of waves. Emphasize patterns in terms of amplitude and wavelength. Examples of models could include diagrams, analogies, and physical models such as water or rope.

Waves

4.3.2: Develop and use a model to describe how visible light waves reflected from objects enter the eye causing objects to be seen. Emphasize the reflection and movement of light. The structure and function of organs and organ systems and the relationship between color and wavelength will be taught in Grades 6 through 8.

Eyes and Vision 1 - Seeing Color
Eyes and Vision 2 - Focusing Light

4.3.3: Design a solution to an information transfer problem using wave patterns. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution. Examples could include using light to transmit a message in Morse code or using lenses and mirrors to see objects that are far away.

Programmable Rover

Fifth Grade

5.1: Characteristics and Interactions of Earth's Systems

5.1.2: Use mathematics and computational thinking to compare the quantity of saltwater and freshwater in various reservoirs to provide evidence for the distribution of water on Earth. Emphasize reservoirs such as oceans, lakes, rivers, glaciers, groundwater, and polar ice caps. Examples of using mathematics and computational thinking could include measuring, estimating, graphing, or finding percentages of quantities.

Water Cycle

5.1.3: Ask questions to plan and carry out investigations that provide evidence for the effects of weathering and the rate of erosion on the geosphere. Emphasize weathering and erosion by water, ice, wind, gravity, or vegetation. Examples could include observing the effects of cycles of freezing and thawing of water on rock or changing the slope in the downhill movement of water.

Erosion Rates
River Erosion
Weathering

5.1.4: Develop a model to describe interactions between Earth's systems including the geosphere, biosphere, hydrosphere, and/or atmosphere. Emphasize interactions between only two systems at a time. Examples could include the influence of a rainstorm in a desert, waves on a shoreline, or mountains on clouds.

Carbon Cycle
Coastal Winds and Clouds
Coastal Winds and Clouds - Metric
Erosion Rates
Hurricane Motion
Hurricane Motion - Metric
River Erosion
Rock Cycle
Water Cycle
Weathering

5.1.5: Design solutions to reduce the effects of naturally occurring events that impact humans. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution. Emphasize that humans cannot eliminate natural hazards, but they can take steps to reduce their impacts. Examples of events could include landslides, earthquakes, tsunamis, blizzards, or volcanic eruptions.

Earthquake-Proof Homes
Flood and Storm-Proof Homes

5.2: Properties and Changes of Matter

5.2.1: Develop and use a model to describe that matter is made of particles on a scale that is too small to be seen. Emphasize making observations of changes supported by a particle model of matter. Examples could include adding air to expand a balloon, compressing air in a syringe, adding food coloring to water, or dissolving salt in water and evaporating the water. The use of the terms atoms and molecules will be taught in Grades 6 through 8.

Phase Changes
Phases of Water
Properties of Matter

5.2.2: Ask questions to plan and carry out investigations to identify substances based on patterns of their properties. Emphasize using properties to identify substances. Examples of properties could include color, hardness, conductivity, solubility, or a response to magnetic forces. Examples of substances could include powders, metals, minerals, or liquids.

Chemical Changes
Circuit Builder
Density
Magnetism
Mineral Identification
Mystery Powder Analysis
Properties of Matter

5.2.3: Plan and carry out investigations to determine the effect of combining two or more substances. Emphasize whether a new substance is or is not created by the formation of a new substance with different properties. Examples could include combining vinegar and baking soda or rusting an iron nail in water.

Chemical Changes
Properties of Matter

5.2.4: Use mathematics and computational thinking to provide evidence that regardless of the type of change that occurs when heating, cooling, or combining substances, the total weight of matter is conserved. Examples could include melting an ice cube, dissolving salt in water, and combining baking soda and vinegar in a closed bag.

Chemical Changes

5.3: Cycling of Matter in Ecosystems

5.3.1: Construct an explanation that plants use air, water, and energy from sunlight to produce plant matter needed for growth. Emphasize photosynthesis at a conceptual level and that plant matter comes mostly from air and water, not from the soil. Photosynthesis at the cellular level will be taught in Grades 6 through 8.

Plants and Snails
Ecosystems

5.3.2: Obtain, evaluate, and communicate information that animals obtain energy and matter from the food they eat for body repair, growth, and motion and to maintain body warmth. Emphasize that the energy used by animals was once energy from the Sun. Cellular respiration will be taught in Grades 6 through 8.

Energy Conversions
Ecosystems

5.3.3: Develop and use a model to describe the movement of matter among plants, animals, decomposers, and the environment. Emphasize that matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Examples could include simple food chains from ecosystems such as deserts or oceans or diagrams of decomposers returning matter to the environment. Complex interactions in a food web will be taught in Grades 6 through 8.

Food Chain
Forest Ecosystem
Prairie Ecosystem
Ecosystems

Sixth Grade

6.1: Structure and Motion Within the Solar System

6.1.1: Develop and use a model of the Sun-Earth-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons. Examples of models could be physical, graphical, or conceptual.

2D Eclipse
3D Eclipse
Eclipse
Moonrise, Moonset, and Phases
Phases of the Moon
Seasons Around the World
Seasons in 3D
Seasons: Earth, Moon, and Sun
Seasons: Why do we have them?
Summer and Winter

6.1.2: Develop and use a model to describe the role of gravity and inertia in orbital motions of objects in our solar system.

Gravity Pitch
Solar System

6.1.3: Use computational thinking to analyze data and determine the scale and properties of objects in the solar system. Examples of scale could include size or distance. Examples of properties could include layers, temperature, surface features, or orbital radius. Data sources could include Earth and space-based instruments such as telescopes or satellites. Types of data could include graphs, data tables, drawings, photographs, or models.

Solar System
Weight and Mass

6.2: Energy Affects Matter

6.2.1: Develop models to show that molecules are made of different kinds, proportions and quantities of atoms. Emphasize understanding that there are differences between atoms and molecules, and that certain combinations of atoms form specific molecules. Examples of simple molecules could include water (H?O), atmospheric oxygen (O?), or carbon dioxide (CO?).

Molecule Builder
Chemical and Physical Changes

6.2.2: Develop a model to predict the effect of heat energy on states of matter and density. Emphasize the arrangement of particles in states of matter (solid, liquid, or gas) and during phase changes (melting, freezing, condensing, and evaporating).

Phase Changes
Phases of Water
Chemical and Physical Changes

6.2.3: Plan and carry out an investigation to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data, and communicating the results of the investigation.

Heat Transfer by Conduction
Phase Changes
Phases of Water
Temperature and Particle Motion

6.2.4: Design an object, tool, or process that minimizes or maximizes heat energy transfer. Identify criteria and constraints, develop a prototype for iterative testing, analyze data from testing, and propose modifications for optimizing the design solution. Emphasize demonstrating how the structure of differing materials allows them to function as either conductors or insulators.

Feel the Heat

6.3: Earth's Weather Patterns and Climate

6.3.1: Develop a model to describe how the cycling of water through Earth's systems is driven by energy from the Sun, gravitational forces, and density

Water Cycle

6.3.2: Investigate the interactions between air masses that cause changes in weather conditions. Collect and analyze weather data to provide evidence for how air masses flow from regions of high pressure to low pressure causing a change in weather. Examples of data collection could include field observations, laboratory experiments, weather maps, or diagrams.

Coastal Winds and Clouds
Coastal Winds and Clouds - Metric
Coriolis Effect
Hurricane Motion
Hurricane Motion - Metric
Weather Maps
Weather Maps - Metric

6.3.3: Develop and use a model to show how unequal heating of the Earth's systems causes patterns of atmospheric and oceanic circulation that determine regional climates. Emphasize how warm water and air move from the equator toward the poles. Examples of models could include Utah regional weather patterns such as lake-effect snow or wintertime temperature inversions.

Coastal Winds and Clouds
Coastal Winds and Clouds - Metric
Convection Cells

6.4: Stability and Change in Ecosystems

6.4.1: Analyze data to provide evidence for the effects of resource availability on organisms and populations in an ecosystem. Ask questions to predict how changes in resource availability affects organisms in those ecosystems. Examples could include water, food, or living space in Utah environments.

Coral Reefs 1 - Abiotic Factors
Coral Reefs 2 - Biotic Factors
Food Chain
Forest Ecosystem
Pond Ecosystem
Prairie Ecosystem
Rabbit Population by Season
Rainfall and Bird Beaks
Rainfall and Bird Beaks - Metric
Ecosystems

6.4.2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments such as competition, predation, and mutualism.

Coral Reefs 1 - Abiotic Factors
Coral Reefs 2 - Biotic Factors
Food Chain
Forest Ecosystem
Pond Ecosystem
Prairie Ecosystem
Animal Group Behavior
Ecosystems
Fruit Production

6.4.3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, or deserts.

Coral Reefs 1 - Abiotic Factors
Food Chain
Forest Ecosystem
Pond Ecosystem
Prairie Ecosystem
Ecosystems

6.4.4: Construct an argument supported by evidence that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, or deserts.

Coral Reefs 1 - Abiotic Factors
Coral Reefs 2 - Biotic Factors
Food Chain
Forest Ecosystem
Pond Ecosystem
Prairie Ecosystem
Rabbit Population by Season
Rainfall and Bird Beaks
Rainfall and Bird Beaks - Metric
Ecosystems
Fruit Production

Seventh Grade

7.1: Forces are Interactions Between Matter

7.1.1: Carry out an investigation which provides evidence that a change in an object's motion is dependent on the mass of the object and the sum of the forces acting on it. Various experimental designs should be evaluated to determine how well the investigation measures an object's motion. Emphasize conceptual understanding of Newton's First and Second Laws. Calculations will only focus on one-dimensional movement; the use of vectors will be introduced in high school.

Fan Cart Physics
Force and Fan Carts

7.1.2: Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects in a system. Examples could include collisions between two moving objects or between a moving object and a stationary object.

Crumple Zones

7.1.3: Construct a model using observational evidence to describe the nature of fields existing between objects that exert forces on each other even though the objects are not in contact. Emphasize the cause and effect relationship between properties of objects (such as magnets or electrically charged objects) and the forces they exert.

Charge Launcher
Magnetism

7.1.4: Collect and analyze data to determine the factors that affect the strength of electric and magnetic forces. Examples could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or of increasing the number or strength of magnets on the speed of an electric motor.

Charge Launcher

7.1.5: Engage in argument from evidence to support the claim that gravitational interactions within a system are attractive and dependent upon the masses of interacting objects. Examples of evidence for arguments could include mathematical data generated from various simulations.

Gravitational Force
Gravity Pitch
Weight and Mass

7.2: Changes to Earth Over Time

7.2.1: Develop a model of the rock cycle to describe the relationship between energy flow and matter cycling that create igneous, sedimentary, and metamorphic rocks. Emphasize the processes of melting, crystallization, weathering, deposition, sedimentation, and deformation, which act together to form minerals and rocks.

Rock Cycle

7.2.2: Construct an explanation based on evidence for how processes have changed Earth's surface at varying time and spatial scales. Examples of processes that occur at varying time scales could include slow plate motions or rapid landslides. Examples of processes that occur at varying spatial scales could include uplift of a mountain range or deposition of fine sediments.

Erosion Rates
Plate Tectonics
River Erosion
Rock Cycle
Weathering

7.2.3: Ask questions to identify constraints of specific geologic hazards and evaluate competing design solutions for maintaining the stability of human-engineered structures, such as homes, roads, and bridges. Examples of geologic hazards could include earthquakes, landslides, or floods.

Hurricane Motion - Metric

7.2.5: Ask questions and analyze and interpret data about the patterns between plate tectonics and:

7.2.5.1: The occurrence of earthquakes and volcanoes.

Plate Tectonics

7.2.5.2: Continental and ocean floor features.

Plate Tectonics

7.2.5.3: The distribution of rocks and fossils.

Building Pangaea

7.3: Structure and Function of Life

7.3.1: Plan and carry out an investigation that provides evidence that the basic structures of living things are cells. Emphasize that cells can form single-celled or multicellular organisms, and multicellular organisms are made of different types of cells.

Cell Types

7.3.2: Develop and use a model to describe the function of a cell in living systems and the way parts of cells contribute to cell function. Emphasize the cell as a system, including the interrelating roles of the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.

Cell Structure
Cell Types

7.3.3: Construct an explanation using evidence to explain how body systems have various levels of organization. Emphasize understanding that cells form tissues, tissues form organs, and organs form systems specialized for particular body functions. Examples could include relationships between the circulatory, excretory, digestive, respiratory, muscular, skeletal, or nervous systems. Specific organ functions will be taught at the high school level.

Cell Types
Circulatory System
Digestive System
Frog Dissection
Muscles and Bones
Senses

7.4: Reproduction and Inheritance

7.4.1: Develop and use a model to explain the effects that different types of reproduction have on genetic variation. Emphasize genetic variation through asexual and sexual reproduction.

Chicken Genetics
Fast Plants® 1 - Growth and Genetics
Fast Plants® 2 - Mystery Parent
Inheritance
Mouse Genetics (One Trait)
Mouse Genetics (Two Traits)
Heredity and Traits

7.4.2: Obtain, evaluate, and communicate information about specific animal and plant adaptations and structures that affect the probability of successful reproduction. Examples of adaptations could include nest building to protect young from the cold, herding of animals to protect young from predators, vocalization of animals and colorful plumage to attract mates for breeding, bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, or hard shells on nuts that squirrels bury.

Flower Pollination
Honeybee Hive
Pollination: Flower to Fruit
Fruit Production

7.4.3: Develop and use a model to describe why genetic mutations may result in harmful, beneficial, or neutral effects to the structure and function of the organism. Emphasize the conceptual idea that changes to traits can happen because of genetic mutations. Specific changes of genes at the molecular level, mechanisms for protein synthesis, and specific types of mutations will be introduced at the high school level.

Evolution: Mutation and Selection
Evolution: Natural and Artificial Selection

7.4.4: Obtain, evaluate, and communicate information about the technologies that have changed the way humans affect the inheritance of desired traits in organisms. Analyze data from tests or simulations to determine the best solution to achieve success in cultivating selected desired traits in organisms. Examples could include artificial selection, genetic modification, animal husbandry, or gene therapy.

Evolution: Natural and Artificial Selection
GMOs and the Environment
Genetic Engineering

7.5: Changes in Species Over Time

7.5.1: Construct an explanation that describes how the genetic variation of traits in a population can affect some individuals' probability of surviving and reproducing in a specific environment. Over time, specific traits may increase or decrease in populations. Emphasize the use of proportional reasoning to support explanations of trends in changes to populations over time. Examples could include camouflage, variation of body shape, speed and agility, or drought tolerance.

Evolution: Mutation and Selection
Evolution: Natural and Artificial Selection
Natural Selection
Rainfall and Bird Beaks
Rainfall and Bird Beaks - Metric

7.5.2: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth, under the assumption that natural laws operate today as in the past.

Human Evolution - Skull Analysis

7.5.3: Construct explanations that describe the patterns of body structure similarities and differences within modern organisms and between ancient and modern organisms to infer possible evolutionary relationships.

Cladograms
Embryo Development
Human Evolution - Skull Analysis

7.5.4: Analyze data to compare patterns in the embryological development across multiple species to identify similarities and differences not evident in the fully formed anatomy.

Embryo Development

Eighth Grade

8.1: Matter and Energy Interact in the Physical World

8.1.1: Develop a model to describe the scale and proportion of atoms and molecules. Emphasize developing atomic models of elements and their numbers of protons, neutrons, and electrons, as well as models of simple molecules. Topics like valence electrons, bond energy, ionic complexes, ions, and isotopes will be introduced at the high school level.

Element Builder

8.1.2: Obtain information about various properties of matter, evaluate how different materials' properties allow them to be used for particular functions in society, and communicate your findings. Emphasize general properties of matter. Examples could include color, density, flammability, hardness, malleability, odor, ability to rust, solubility, state, or the ability to react with water.

Circuit Builder
Density Experiment: Slice and Dice
Density Laboratory
Density via Comparison
Determining Density via Water Displacement
Magnetism
Mineral Identification
Mystery Powder Analysis
Phases of Water
Solubility and Temperature
pH Analysis
pH Analysis: Quad Color Indicator

8.1.3: Plan and conduct an investigation and then analyze and interpret the data to identify patterns in changes in a substance's properties to determine whether a chemical reaction has occurred. Examples could include changes in properties such as color, density, flammability, odor, solubility, or state.

Chemical Changes
Chemical and Physical Changes

8.1.5: Develop a model that uses computational thinking to illustrate cause and effect relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. Emphasize molecular-level models of solids, liquids, and gases to show how adding or removing heat energy can result in phase changes, and focus on calculating the density of a substance's state.

Melting Points
Phase Changes
Phases of Water
Temperature and Particle Motion

8.1.6: Develop a model to describe how the total number of atoms does not change in a chemical reaction, indicating that matter is conserved. Emphasize demonstrations of an understanding of the law of conservation of matter. Balancing equations and stoichiometry will be learned at the high school level.

Chemical Changes
Chemical Equations
Chemical and Physical Changes

8.2: Energy is Stored and Transferred in Physical Systems

8.2.1: Use computational thinking to analyze data about the relationship between the mass and speed of objects and the relative amount of kinetic energy of the objects. Emphasis should be on the quantity of mass and relative speed to the observable effects of the kinetic energy. Examples could include a full cart vs. an empty cart or rolling spheres with different masses down a ramp to measure the effects on stationary masses. Calculations of kinetic and potential energy will be learned at the high school level.

Energy of a Pendulum
Inclined Plane - Sliding Objects
Roller Coaster Physics
Sled Wars
Trebuchet

8.2.2: Ask questions about how the amount of potential energy varies as distance within the system changes. Plan and conduct an investigation to answer a question about potential energy. Emphasize comparing relative amounts of energy. Examples could include a cart at varying positions on a hill or an object being dropped from different heights. Calculations of kinetic and potential energy will be learned at the high school level.

Energy Conversion in a System
Energy of a Pendulum
Inclined Plane - Sliding Objects
Potential Energy on Shelves
Roller Coaster Physics
Sled Wars
Trebuchet

8.2.3: Engage in argument to identify the strongest evidence that supports the claim that the kinetic energy of an object changes as energy is transferred to or from the object. Examples could include observing temperature changes as a result of friction, applying force to an object, or releasing potential energy from an object.

Air Track
Energy Conversion in a System
Sled Wars

8.2.4: Use computational thinking to describe a simple model for waves that shows the pattern of wave amplitude being related to wave energy. Emphasize describing waves with both quantitative and qualitative thinking. Examples could include using graphs, charts, computer simulations, or physical models to demonstrate amplitude and energy correlation.

Waves

8.2.5: Develop and use a model to describe the structure of waves and how they are reflected, absorbed, or transmitted through various materials. Emphasize both light and mechanical waves. Examples could include drawings, simulations, or written descriptions of light waves through a prism; mechanical waves through gas vs. liquids vs. solids; or sound waves through different mediums.

Basic Prism
Color Absorption
Earthquakes 1 - Recording Station
Eyes and Vision 1 - Seeing Color
Heat Absorption
Laser Reflection
Longitudinal Waves
Radiation
Refraction

Ripple Tank
Waves

8.3: Life Systems Store and Transfer Matter and Energy

8.3.1: Plan and conduct an investigation and use the evidence to construct an explanation of how photosynthetic organisms use energy to transform matter. Emphasize molecular and energy transformations during photosynthesis.

Cell Energy Cycle
Photosynthesis Lab
Plants and Snails

8.3.2: Develop a model to describe how food is changed through chemical reactions to form new molecules that support growth and/or release energy as matter cycles through an organism. Emphasize describing that during cellular respiration molecules are broken apart and rearranged into new molecules, and that this process releases energy.

Cell Energy Cycle
Digestive System

8.3.3: Ask questions to obtain, evaluate, and communicate information about how changes to an ecosystem affect the stability of cycling matter and the flow of energy among living and nonliving parts of an ecosystem. Emphasize describing the cycling of matter and flow of energy through the carbon cycle.

Carbon Cycle
Coral Reefs 1 - Abiotic Factors
Coral Reefs 2 - Biotic Factors
Food Chain
Forest Ecosystem
Pond Ecosystem
Prairie Ecosystem
Ecosystems

8.4: Interactions with Natural Systems and Resources

8.4.1: Construct a scientific explanation based on evidence that shows that the uneven distribution of Earth's mineral, energy, and groundwater resources is caused by geological processes. Examples of uneven distribution of resources could include Utah's unique geologic history that led to the formation and irregular distribution of natural resources like copper, gold, natural gas, oil shale, silver, or uranium.

Carbon Cycle

8.4.2: Engage in argument supported by evidence about the effect of per capita consumption of natural resources on Earth's systems. Emphasize that these resources are limited and may be non-renewable. Examples of evidence include rates of consumption of food and natural resources such as freshwater, minerals, or energy sources.

Carbon Cycle
Coral Reefs 2 - Biotic Factors

8.4.3: Design a solution to monitor or mitigate the potential effects of the use of natural resources. Evaluate competing design solutions using a systematic process to determine how well each solution meets the criteria and constraints of the problem. Examples of uses of the natural environment could include agriculture, conservation efforts, recreation, solar energy, or water management.

GMOs and the Environment

8.4.4: Analyze and interpret data on the factors that change global temperatures and their effects on regional climates. Examples of factors could include agricultural activity, changes in solar radiation, fossil fuel use, or volcanic activity. Examples of data could include graphs of the atmospheric levels of gases, seawater levels, ice cap coverage, human activities, or maps of global and regional temperatures.

Carbon Cycle
Greenhouse Effect
Greenhouse Effect - Metric

8.4.5: Analyze and interpret patterns of the occurrence of natural hazards to forecast future catastrophic events, and investigate how data are used to develop technologies to mitigate their effects. Emphasize how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow prediction, but others, such as earthquakes, may occur without warning.

Hurricane Motion
Hurricane Motion - Metric

Earth and Space Sciences

ESS.1: Matter and Energy in Space

ESS.1.1: Develop a model based on evidence to illustrate the life span of the Sun and the role of nuclear fusion releasing energy in the Sun's core. Emphasize energy transfer mechanisms that allow energy from nuclear fusion to reach Earth. Examples of evidence for the model could include observations of the masses and lifetimes of other stars, or non-cyclic variations over centuries.

H-R Diagram
Nuclear Reactions

ESS.1.2: Construct an explanation of the Big Bang theory based on astronomical evidence of electromagnetic radiation, motion of distant galaxies, and composition of matter in the universe. Emphasize redshift of electromagnetic radiation, cosmic microwave background radiation, and the observed composition and distribution of matter in the universe.

Big Bang Theory - Hubble's Law

ESS.1.3: Develop a model to illustrate the changes in matter occurring in a star's life cycle. Emphasize that the way different elements are created varies as a function of the mass of a star and the stage of its lifetime.

H-R Diagram

ESS.2: Patterns in Earth's History and Processes

ESS.2.2: Develop and use a model based on evidence of Earth's interior and describe the cycling of matter by thermal convection. Emphasize the density of Earth's layers and mantle convection driven by radioactive decay and heat from Earth's early formation. Examples of evidence could include maps of Earth's three-dimensional structure obtained from seismic waves or records of the rate of change of Earth's magnetic field.

Convection Cells
Plate Tectonics

ESS.2.3: Construct an explanation for how plate tectonics results in patterns on Earth's surface. Emphasize past and current plate motions. Examples could include continental and ocean floor features such as mountain ranges and mid-ocean ridges, magnetic polarity preserved in seafloor rocks, or regional hot spots.

Plate Tectonics

ESS.2.4: Develop and use a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales. Emphasize how the appearance of land and seafloor features are a result of both constructive forces and destructive mechanisms. Examples of constructive forces could include tectonic uplift or mountain building. Examples of destructive mechanisms could include weathering or mass wasting.

Erosion Rates
Plate Tectonics
River Erosion
Weathering

ESS.3: System Interactions: Atmosphere, Hydrosphere, and Geosphere

ESS.3.1: Plan and carry out an investigation of the properties of water and its effects on Earth materials and surface processes. Examples of properties could include water's capacity to expand upon freezing, dissolve and transport material, or absorb, store, and release energy.

Erosion Rates
River Erosion
Rock Cycle
Water Cycle
Weathering

ESS.3.2: Construct an explanation of how heat (energy) and water (matter) move throughout the oceans causing patterns in weather and climate. Emphasize the mechanisms for surface and deep ocean movement. Examples of mechanisms for surface movement could include wind, Sun's energy, or the Coriolis effect. Examples of mechanisms for deep ocean movement could include water density differences due to temperature or salinity.

Convection Cells
Coriolis Effect

ESS.3.3: Construct an explanation for how energy from the Sun drives atmospheric processes and how atmospheric currents transport matter and transfer energy. Emphasize how energy from the Sun is reflected, absorbed, or scattered; how the greenhouse effect contributes to atmospheric energy; and how uneven heating of Earth's atmosphere combined with the Coriolis effect creates an atmospheric circulation system.

Greenhouse Effect
Greenhouse Effect - Metric

ESS.3.5: Develop and use a quantitative model to describe the cycling of carbon among Earth's systems. Emphasize each of Earth's systems (hydrosphere, atmosphere, geosphere, and biosphere) and how the movement of carbon from one system to another can result in changes to the system(s). Examples could include more carbon absorbed in the oceans leading to ocean acidification or more carbon present in the atmosphere leading to a stronger greenhouse effect.

Carbon Cycle

ESS.3.6: Analyze and interpret data from global climate records to illustrate changes to Earth's systems throughout geologic time and make predictions about future variations using modern trends. Examples of data could include average sea surface temperature, average air temperature, composition of gasses in ice cores, or tree rings.

Hydrologic Cycle

ESS.3.7: Engage in argument from evidence to support the claim that one change to Earth's surface can create climate feedback loops that cause changes to other systems. Examples of climate feedbacks could include ice-albedo or warming oceans.

Carbon Cycle
Hydrologic Cycle

ESS.4: Stability and Change in Natural Resources

ESS.4.4: Evaluate design solutions for a major global or local environmental problem based on one of Earth's systems. Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution. Examples of major global or local problems could include water pollution or availability, air pollution, deforestation, or energy production.

Hydrologic Cycle
Nitrogen Cycle
Photosynthesis

Chemistry

CHEM.1: The Structure and Properties of Atoms

CHEM.1.1: Obtain, evaluate, and communicate information regarding the structure of the atom on the basis of experimental evidence. Emphasize the relationship between proton number and element identity, isotopes, and electrons in atoms. Examples of experimental evidence could include the gold foil experiment, cathode ray tube, or atomic spectrum data.

Element Builder
Isotopes

CHEM.1.2: Analyze and interpret data to identify patterns in the stability of isotopes and predict likely modes of radioactive decay. Emphasize that different isotopes of the same element decay by different modes and at different rates depending on their nuclear stability. Examples of data could include band of stability charts, mass or nuclear binding energy per nucleon, or the inverse relationship between half-life and nuclear stability.

Half-life
Isotopes
Nuclear Decay

CHEM.1.3: Use mathematics and computational thinking to relate the rates of change in quantities of radioactive isotopes through radioactive decay (alpha, beta, and positron) to ages of materials or persistence in the environment. Emphasize a conceptual understanding of half-life. Examples could include radiocarbon dating, nuclear waste management, or nuclear medicine.

Half-life

CHEM.1.4: Construct an explanation about how fusion can form new elements with greater or lesser nuclear stability. Emphasize the nuclear binding energy, with the conceptual understanding that when fusion of elements results in a more stable nucleus, large quantities of energy are released, and when fusion results in a less stable nucleus, large quantities of energy are required. Examples could include the building up of elements in the universe starting with hydrogen to form heavier elements, the composition of stars, or supernovae producing heavy elements.

Nuclear Reactions

CHEM.1.5: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. Emphasize conceptual understanding of trends and patterns. Examples could include trends in ionization energy, atomic radius, or electronegativity. Examples of properties for main group elements could include general reactivity, bonding type, or ion formation.

Electron Configuration
Element Builder
Periodic Trends

CHEM.2: The Structure and Properties of Molecules

CHEM.2.1: Analyze data to predict the type of bonding most likely to occur between two elements using the patterns of reactivity on the periodic table. Emphasize the types and strengths of attractions between charged particles in ionic, covalent, and metallic bonds. Examples could include the attraction between electrons on one atom and the nucleus of another atom in a covalent bond or between ions in an ionic compound.

Covalent Bonds
Ionic Bonds
Polarity and Intermolecular Forces
Electrons and Chemical Reactions

CHEM.2.2: Plan and carry out an investigation to compare the properties of substances at the bulk scale and relate them to molecular structures. Emphasize using models to explain or describe the strength of electrical forces between particles. Examples of models could include Lewis dot structures or ball and stick models. Examples of particles could include ions, atoms, molecules, or networked materials (such as graphite). Examples of properties could include melting point and boiling point, vapor pressure, solubility, or surface tension.

Melting Points
Polarity and Intermolecular Forces
Sticky Molecules

CHEM.3: Stability and Change in Chemical Systems

CHEM.3.1: Use mathematics and computational thinking to analyze the distribution and proportion of particles in solution. Emphasize proportional reasoning and the impact of concentration on solution properties, rather than algorithmic calculations. Examples of concentrations affecting solutions could include the Beer-Lambert Law, colligative properties, or pH.

Colligative Properties
Titration

CHEM.3.2: Analyze data to identify patterns that assist in making predictions of the outcomes of simple chemical reactions. Emphasize patterns based on the outermost electrons of atoms, trends in the periodic table, and knowledge of chemical properties. Examples could include reactions between main group elements, combustion reactions, or reactions between Arrhenius acids and bases.

Balancing Chemical Equations
Chemical Changes
Chemical Equations
Periodic Trends
Electrons and Chemical Reactions

CHEM.3.3: Plan and carry out an investigation to observe the change in properties of substances in a chemical reaction to relate the macroscopically observed properties to the molecular level changes in bonds and the symbolic notation used in chemistry. Emphasize that the visible macroscopic changes in chemical reactions are a result of changes on the molecular level. Examples of observable properties could include changes in color or the production of a solid or gaseous product.

Chemical Changes
Electrons and Chemical Reactions

CHEM.3.4: Use mathematics and computational thinking to support the observation that matter is conserved during chemical reactions and matter cycles. Emphasize that chemical reactions occur on both small and global scales, and that matter is always conserved. Examples of small scale reactions could include ratios of reactants and products in a single chemical reaction or simple stoichiometric calculation. Examples of global scale matter cycles could include tracing carbon through the chemical reactions of photosynthesis, combustion, or respiration.

Balancing Chemical Equations
Chemical Changes
Chemical Equations
Moles
Stoichiometry
Water Crisis

CHEM.3.6: Construct an explanation using experimental evidence for how reaction conditions affect the rate of change of a reaction. Emphasize collision theory as an explanatory principle. Examples of reaction conditions could include temperature, concentration, particle size, or presence of a catalyst.

Collision Theory

CHEM.3.7: Design a solution that would refine a chemical system by specifying a change in conditions that would produce increased or decreased amounts of a product at equilibrium. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Emphasize a qualitative understanding of Le Châtelier's Principle and connections between macroscopic and molecular level changes.

Equilibrium and Concentration
Equilibrium and Pressure
Ocean Carbon Equilibrium

CHEM.4: Energy in Chemical Systems

CHEM.4.1: Construct an argument from evidence about whether a simple chemical reaction absorbs or releases energy. Emphasize that the overall change in energy is related to the energy absorbed when bonds are broken and the energy released when bonds are formed. Examples could include chemical reactions releasing or absorbing energy to or from the surrounding solution or the metabolism of glucose.

Feel the Heat
Reaction Energy

CHEM.4.2: Construct an explanation of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. Emphasize a qualitative understanding. Examples could include that low energy electromagnetic radiation can increase molecular rotation and bond vibration, visible light can cause electronic transitions, and high energy electromagnetic radiation can result in ionization and bond breaking.

Herschel Experiment
Herschel Experiment - Metric
Photoelectric Effect
Radiation

CHEM.4.3: Design a device that converts energy from one form into another to solve a problem. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Emphasize chemical potential energy as a type of stored energy. Examples of sources of chemical potential energy could include oxidation-reduction or combustion reactions.

Feel the Heat

CHEM.4.4: Use models to describe the changes in the composition of the nucleus of the atom during nuclear processes, and compare the energy released during nuclear processes to the energy released during chemical processes. Emphasize a qualitative understanding of nuclear changes. Examples of nuclear processes could include the formation of elements through fusion in stars, generation of electricity in a nuclear power plant, radioactive decay, or the use of radioisotopes in nuclear medicine.

Nuclear Decay
Nuclear Reactions

Biology

BIO.1: Interactions with Organisms and the Environment

BIO.1.1: Plan and carry out an investigation to analyze and interpret data to determine how biotic and abiotic factors can affect the stability and change of a population. Emphasize stability and change in populations' carrying capacities and an ecosystem's biodiversity.

Coral Reefs 1 - Abiotic Factors
Coral Reefs 2 - Biotic Factors
Food Chain
Forest Ecosystem
Pond Ecosystem
Prairie Ecosystem
Rabbit Population by Season
Rainfall and Bird Beaks - Metric
Photosynthesis

BIO.1.2: Develop and use a model to explain cycling of matter and flow of energy among organisms in an ecosystem. Emphasize the movement of matter and energy through the different living organisms in an ecosystem. Examples of models could include food chains, food webs, energy pyramids or pyramids of biomass.

Coral Reefs 1 - Abiotic Factors
Food Chain
Forest Ecosystem
Ecosystems

BIO.1.3: Analyze and interpret data to determine the effects of photosynthesis and cellular respiration on the scale and proportion of carbon reservoirs in the carbon cycle. Emphasize the cycling of carbon through the biosphere, atmosphere, hydrosphere, and geosphere and how changes to various reservoirs impact ecosystems. Examples of changes to the scale and proportion of reservoirs could include deforestation, fossil fuel combustion, or ocean uptake of carbon dioxide.

Carbon Cycle
Cell Energy Cycle

BIO.1.4: Develop an argument from evidence for how ecosystems maintain relatively consistent numbers and types of organisms in stable conditions. Emphasize how changing conditions may result in changes to an ecosystem. Examples of changes in ecosystem conditions could include moderate biological or physical changes such as moderate hunting or a seasonal flood; and extreme changes, such as climate change, volcanic eruption, or sea level rise.

Coral Reefs 1 - Abiotic Factors
Coral Reefs 2 - Biotic Factors
Food Chain
Forest Ecosystem
Pond Ecosystem
Prairie Ecosystem
Rabbit Population by Season
Rainfall and Bird Beaks
Photosynthesis

BIO.1.5: Design a solution that reduces the impact caused by human activities on the environment and biodiversity. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Examples of human activities could include building dams, pollution, deforestation, or introduction of invasive species.

GMOs and the Environment
Nitrogen Cycle
Photosynthesis

BIO.2: Structure and Function of Life

BIO.2.1: Construct an explanation based on evidence that all organisms are primarily composed of carbon, hydrogen, oxygen, and nitrogen, and that the matter taken into an organism is broken down and recombined to make macromolecules necessary for life functions. Emphasize that molecules are often transformed through enzymatic processes and the atoms involved are used to make carbohydrates, proteins, fats/lipids, and nucleic acids.

Dehydration Synthesis
Enzymes

BIO.2.2: Ask questions to plan and carry out an investigation to determine how (a) the structure and function of cells, (b) the proportion and quantity of organelles, and (c) the shape of cells result in cells with specialized functions. Examples could include mitochondria in muscle and nerve cells, chloroplasts in leaf cells, ribosomes in pancreatic cells, or the shape of nerve cells and muscle cells.

Cell Structure
Cell Types

BIO.2.3: Develop and use a model to illustrate the cycling of matter and flow of energy through living things by the processes of photosynthesis and cellular respiration. Emphasize how the products of one reaction are the reactants of the other and how the energy transfers in these reactions.

Cell Energy Cycle
Cell Respiration
Photosynthesis

BIO.2.4: Plan and carry out an investigation to determine how cells maintain stability within a range of changing conditions by the transport of materials across the cell membrane. Emphasize that large and small particles can pass through the cell membrane to maintain homeostasis.

Osmosis
Paramecium Homeostasis
Diffusion
Homeostasis
Osmosis

BIO.2.5: Construct an explanation about the role of mitosis in the production, growth, and maintenance of systems within complex organisms. Emphasize the major events of the cell cycle including cell growth and DNA replication, separation of chromosomes, and separation of cell contents.

Cell Division
Embryo Development
Meiosis
Meowsis

BIO.2.6: Ask questions to develop an argument for how the structure and function of interacting organs and organ systems, that make up multicellular organisms, contribute to homeostasis within the organism. Emphasize the interactions of organs and organ systems with the immune, endocrine, and nervous systems.

Homeostasis

BIO.2.7: Plan and carry out an investigation to provide evidence of homeostasis and that feedback mechanisms maintain stability in organisms. Examples of investigations could include heart rate response to changes in activity, stomata response to changes in moisture or temperature, or root development in response to variations in water level.

Homeostasis
Human Homeostasis
Paramecium Homeostasis
Enzymes
Homeostasis

BIO.3: Genetic Patterns

BIO.3.1: Construct an explanation for how the structure of DNA is replicated, and how DNA and RNA code for the structure of proteins which regulate and carry out the essential functions of life and result in specific traits. Emphasize a conceptual understanding that the sequence of nucleotides in DNA determines the amino acid sequence of proteins through the processes of transcription and translation.

Building DNA
Genetic Engineering
RNA and Protein Synthesis
Meowsis
Protein Synthesis

BIO.3.2: Use computational thinking and patterns to make predictions about the expression of specific traits that are passed in genes on chromosomes from parents to offspring. Emphasize that various inheritance patterns can be predicted by observing the way genes are expressed. Examples of tools to make predictions could include Punnett squares, pedigrees, or karyotypes. Examples of allele crosses could include dominant/recessive, incomplete dominant, codominant, or sex-linked alleles.

Chicken Genetics
Fast Plants® 1 - Growth and Genetics
Fast Plants® 2 - Mystery Parent
Hardy-Weinberg Equilibrium
Human Karyotyping
Microevolution

Mouse Genetics (One Trait)
Mouse Genetics (Two Traits)

BIO.3.3: Engage in argument from evidence that inheritable genetic variation is caused during the formation of gametes. Emphasize that genetic variation may be caused by epigenetics, during meiosis from new genetic combinations, or viable mutations.

Evolution: Mutation and Selection
Meiosis
Meowsis

BIO.3.4: Plan and carry out an investigation and use computational thinking to explain the variation and patterns in distribution of the traits expressed in a population. Emphasize the distribution of traits as it relates to both genetic and environmental influences on the expression of those traits. Examples of variation and patterns in distribution of traits could include sickle-cell anemia and malaria, hemoglobin levels in humans at high elevation, or antibiotic resistance.

Hardy-Weinberg Equilibrium
Microevolution

BIO.3.5: Evaluate design solutions where biotechnology was used to identify and/or modify genes in order to solve (effect) a problem. Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution. Emphasize arguments that focus on how effective the solution was at meeting the desired outcome.

GMOs and the Environment
Genetic Engineering

BIO.4: Evolutionary Change

BIO.4.1: Obtain, evaluate, and communicate information to identify the patterns in the evidence that support biological evolution. Examples of evidence could include DNA sequences, amino acid sequences, anatomical structures, the fossil record, or order of appearance of structures during embryological development.

Cladograms
Embryo Development
Human Evolution - Skull Analysis
RNA and Protein Synthesis

BIO.4.2: Construct an explanation based on evidence that natural selection is a primary cause of evolution. Emphasize that natural selection is primarily caused by the potential for a species to increase in number, the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, competition for limited resources, and the proliferation of those organisms that are better able to survive and reproduce in the environment.

Evolution: Mutation and Selection
Natural Selection
Rainfall and Bird Beaks
Rainfall and Bird Beaks - Metric
Evolution

BIO.4.3: Analyze and interpret data to identify patterns that explain the claim that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Emphasize analyzing shifts in the numerical distribution of traits and using these shifts as evidence to support explanations.

Evolution: Mutation and Selection
Microevolution
Natural Selection
Rainfall and Bird Beaks - Metric
Evolution

BIO.4.4: Engage in argument from evidence that changes in environmental conditions may cause increases in the number of individuals of some species, the emergence of new species over time, and/or the extinction of other species. Emphasize the cause and effect relationships for how changes and the rate of change to the environment affect distribution or disappearance of traits in a species. Examples of changes in environmental conditions could include deforestation, application of fertilizers, drought, or flood.

Coral Reefs 1 - Abiotic Factors
Coral Reefs 2 - Biotic Factors
Natural Selection
Rainfall and Bird Beaks
Rainfall and Bird Beaks - Metric
Evolution

Physics

PHYS.1: Forces and Interactions

PHYS.1.1: Analyze and interpret data to determine the cause and effect relationship between the net force on an object and its change in motion as summarized by Newton's Second Law of Motion. Emphasize one-dimensional motion and macroscopic objects moving at non-relativistic speeds. Examples could include objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.

Atwood Machine
Fan Cart Physics

PHYS.1.2: Use mathematics and computational thinking to support the claim that the total momentum of a system is conserved when there is no net force acting on the system. Emphasize the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. Examples could include one-dimensional elastic or inelastic collisions between objects within the system.

2D Collisions
Air Track

PHYS.1.3: Design a solution that has the function of minimizing the impact force on an object during a collision. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Emphasize problems that require application of Newton's Second Law of Motion or conservation of momentum.

Crumple Zones

PHYS.2: Energy

PHYS.2.1: Analyze and interpret data to track and calculate the transfer of energy within a system. Emphasize the identification of the components of the system, along with their initial and final energies, and mathematical descriptions to depict energy transfer in the system. Examples of energy transfer could include the transfer of energy during a collision or heat transfer.

Energy Conversion in a System
Energy of a Pendulum
Inclined Plane - Rolling Objects
Inclined Plane - Simple Machine

Inclined Plane - Sliding Objects
Sled Wars

PHYS.2.2: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system. Emphasize that uniform distribution of energy is a natural tendency. Examples could include the measurement of the reduction of temperature of a hot object or the increase in temperature of a cold object.

Calorimetry Lab
Conduction and Convection
Heat Transfer by Conduction

PHYS.2.3: Develop and use models on the macroscopic scale to illustrate that energy can be accounted for as a combination of energies associated with the motion of objects and energy associated with the relative positions of objects. Emphasize relationships between components of the model to show that energy is conserved. Examples could include mechanical systems where kinetic energy is transformed to potential energy or vice versa.

Energy Conversion in a System
Energy of a Pendulum
Inclined Plane - Rolling Objects
Inclined Plane - Sliding Objects
Potential Energy on Shelves
Roller Coaster Physics
Trebuchet

PHYS.2.4: Design a solution by constructing a device that converts one form of energy into another form of energy to solve a complex real-life problem. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Examples of energy transformation could include electrical energy to mechanical energy, mechanical energy to electrical energy, or electromagnetic radiation to thermal energy.

Feel the Heat
Trebuchet

PHYS.3: Fields

PHYS.3.1: Use mathematics and computational thinking to compare the scale and proportion of gravitational and electric fields using Newton's Law of Gravitation and Coulomb's Law. Emphasize the comparative strength of these two field forces, the effect of distance between interacting objects on the magnitudes of these forces, and the use of models to understand field forces.

Coulomb Force (Static)
Gravitational Force
Pith Ball Lab

PHYS.3.2: Plan and conduct an investigation to provide evidence that an electric current causes a magnetic field and that a changing magnetic field causes an electric current. Emphasize the qualitative relationship between electricity and magnetism without necessarily conducting quantitative analysis. Examples could include electromagnets or generators.

Electromagnetic Induction
Magnetic Induction

PHYS.3.3: Analyze and interpret data to compare the effect of changes in position of interacting objects on electric and gravitational forces and energy. Emphasize the similarities and differences between charged particles in electric fields and masses in gravitational fields. Examples could include models, simulations, or experiments that produce data or illustrate field lines between objects.

Charge Launcher
Coulomb Force (Static)
Electromagnetic Induction
Magnetic Induction

PHYS.3.4: Develop and use a model to evaluate the effects on a field as characteristics of its source and surrounding space are varied. Emphasize how a field changes with distance from its source. Examples of electric fields could include those resulting from point charges. Examples of magnetic fields could include those resulting from dipole magnets or current-bearing wires.

Electromagnetic Induction
Magnetic Induction

PHYS.4: Waves

PHYS.4.1: Analyze and interpret data to derive both qualitative and quantitative relationships based on patterns observed in frequency, wavelength, and speed of waves traveling in various media. Emphasize mathematical relationships and qualitative descriptions. Examples of data could include electromagnetic radiation traveling in a vacuum or glass, sound waves traveling through air or water, or seismic waves traveling through Earth.

Earthquakes 1 - Recording Station
Longitudinal Waves
Refraction
Ripple Tank
Waves

PHYS.4.2: Engage in argument based on evidence that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model better explains interactions within a system than the other. Emphasize how the experimental evidence supports the claim and how models and explanations are modified in light of new evidence. Examples could include resonance, interference, diffraction, or the photoelectric effect.

Basic Prism
Photoelectric Effect

PHYS.4.3: Evaluate information about the effects that different frequencies of electromagnetic radiation have when absorbed by biological materials. Emphasize that the energy of electromagnetic radiation is directly proportional to frequency and that the potential damage to living tissue from electromagnetic radiation depends on the energy of the radiation.

Heat Absorption
Herschel Experiment - Metric
Photoelectric Effect
Radiation

PHYS.4.5: Obtain, evaluate, and communicate information about how devices use the principles of electromagnetic radiation and their interactions with matter to transmit and capture information and energy. Emphasize the ways in which devices leverage the wave-particle duality of electromagnetic radiation. Examples could include solar cells, medical imaging devices, or communication technologies.

Phased Array