Unit 1: Exponents

Unit Overview: Students will discover and practice the properties of integer exponents to generate equivalent numerical expressions. Students will explore the power properties of zero and negative exponents to generate equivalent numerical expressions and convert numbers with negative exponents to fractions and decimals. They will apply the properties to real-world and mathematical situations, continuing to build on their knowledge of exponents, order of operations, and the application of properties to simplify exponential expressions. (Focus on MP.3, MP.7, MP.8)

Concept 1: Understand Rules of Exponents

Concept Overview: Students investigate the properties of integer exponents to generate equivalent numerical expressions. Then, they apply the properties of exponents to real-world and mathematical situations, continuing to build on their knowledge of order of operations as they simplify exponential expressions.

Unit 1, Concept 1 Standards
- 8.EE.A.1

Concept 2: Understand Negative Exponents

Concept Overview: Students discover and practice applying the properties of integer exponents, including the power properties of zero and negative exponents, to generate equivalent numerical expressions and convert numbers with negative exponents to fractions and decimals. They then apply the properties to real-world and mathematical situations, continuing to build on their knowledge of exponents, order of operations, and the application of properties to simplify exponential expressions.

Unit1, Concept 2 Standards
- 8.EE.A.1

Unit 2: Real Numbers

Unit Overview: Students will extend properties of integer exponents to include fractional exponents of 1/2 and 1/3 and connect their understanding to roots and radicals. They will generate squares and cubes of the numbers from 1 to 10 and identify perfect and non-perfect squares and cubes. They will find the square roots and cube roots of perfect squares and cubes, respectively, and estimate the square roots or cube roots of non-perfect square or cubic numbers. Students will recognize that fractions and decimals both represent part of a whole, and that they can be converted to an equivalent value using a different form. They will explore patterns in the denominators of fractions and connect those patterns to determine whether rational decimal expressions will terminate or repeat. Students will explore and define the set of irrational numbers by analyzing such examples as π and $\sqrt{2}$. They will learn to identify square roots of non-perfect squares as irrational numbers and use square numbers to approximate the values of square roots. (Focus on MP.6, MP.7, MP.8)

Concept 1: Investigate Square Roots and Cube Roots

Concept Overview: Students build on their knowledge of properties of integer exponents to include fractional exponents of 1/2 and 1/3 and connect their understanding to roots and radicals. They generate squares and cubes of the numbers from 1 to 10 and identify perfect and non-perfect squares and cubes. They find the square roots and cube roots of perfect squares and cubes, respectively, and estimate the square roots or cube roots of non-perfect square or cubic numbers. Students then apply their understanding of powers to solve simple equations that require finding a square or cubic root.

Unit 2, Concept 1 Standards
- 8.EE.A.1
- 8.EE.A.2

Concept 2: Convert Between Decimals and Fractions

Concept Overview: Students recognize that fractions and decimals both represent part of a whole, and that they can be converted to an equivalent value using a different form. They explore patterns in the denominators of fractions and connect those patterns to determine whether rational decimal expressions will terminate or repeat. They apply equations and the multiplication and subtraction properties of equality to convert decimals, whether terminating or repeating, to fractional forms.

Unit 2, Concept 2 Standards
- 8.NS.A.1

Concept 3: Compare Rational and Irrational Numbers

Concept Overview: Students explore and define the set of irrational numbers by analyzing such examples as π and $\sqrt{2}$. They learn to identify square roots of non-perfect squares as irrational numbers, and they use square numbers to approximate the values of square roots. They also use rational numbers to approximate irrational numbers.

Unit 2, Concept 3 Standards
- 8.NS.A.1
- 8.NS.A.2
- 8.EE.A.2

Unit 3: Congruence and Similarity

Unit Overview: Students will discover rigid transformations and explore properties that are preserved by translations, rotations, and reflections. They will use coordinates to explore transformations on the coordinate plane. Students will continue their study of the basic rigid motion transformations: rotations, reflections, and translations. They will discover how these basic transformations can be combined. Students will confirm that key properties of rotations, reflections, and translations are preserved when transformations are combined. They will identify a sequence of rigid motion transformations that will map one figure onto another when given the pre-image and image, including figures in the coordinate plane. Students will extend their work with scale figures and similarity. They will explore the images of figures under a dilation as they work to determine which geometric properties are preserved under dilations. Students will discover how scale factors greater than 1 and less than 1 impact the size of a pre-image. They will connect their understanding of congruence and similarity by seeing that similar figures with a scale factor of 1 are also congruent. (Focus on MP.3, MP.5, MP.7)

Concept 1: Investigate Geometric Transformations

Concept Overview: Students are introduced to rigid transformations and explore properties that are preserved by translations, rotations, and reflections. They also build on their earlier work with technology as they use the dynamic geometry tool to perform and analyze rigid transformations. In addition, students use coordinates to explore transformations on the coordinate plane.

Unit 3, Concept 1 Standards
- 8.G.A.1
- 8.G.A.1a
- 8.G.A.1b
- 8.G.A.1c
- 8.G.A.3

Concept 2: Perform Multiple Transformations

Concept Overview: Students continue their study of the basic rigid motion transformations: rotations, reflections, and translations. They discover how these basic transformations can be combined. Students confirm that key properties of rotations, reflections, and translations are preserved when transformations are combined. Students identify a sequence of rigid motion transformations that map one figure onto another when given the pre-image and image, including figures in the coordinate plane.

Unit 3, Concept 2 Standards
- 8.G.A.1
- 8.G.A.1a
- 8.G.A.1b
- 8.G.A.1c
- 8.G.A.2
- 8.G.A.3

Concept 3: Represent Similarity with Proportions

Concept Overview: Students extend their work with scale figures and similarity. They explore the images of figures under a dilation as they work to determine which geometric properties are preserved under dilations. Students discover that two geometric figures are similar if, and only if, there is a sequence of transformations that maps one figure onto the other, and they learn how to create such a sequence. They explore how scale factors greater than 1 and less than 1 impact the size of a pre-

Unit 3, Concept 3 Standards
- 8.G.A.3
- 8.G.A.4
- 8.G.A.5

image. They also have the opportunity to see what different centers of dilation do when they apply a specific scale factor. Students connect their understanding of congruence and similarity by seeing that similar figures with a scale factor of 1 are also congruent.

Unit 4: The Pythagorean Theorem

Unit Overview: In this unit, students will apply their understanding of congruence and similarity to analyze right triangles, develop an understanding of the statement of the Pythagorean theorem, and explain why the Pythagorean theorem holds. They will apply the Pythagorean theorem to find distances between points on the coordinate plane and to find lengths of sides of a right triangle. Students will learn that the measures of sides of a right triangle determine whether the triangle is a right triangle. They will explain a proof of the converse of the Pythagorean theorem and apply the converse to solve real-world and mathematical problems. Students will derive the distance formula from the Pythagorean theorem. They will apply their understanding of the distance formula and the Pythagorean Theorem to solve real-world and mathematical problems in 2-D and 3-D. (Focus on MP.3, MP.7, MP.8)

Concept 1: Investigate the Pythagorean Theorem

Concept Overview: Students use their knowledge of congruence and similarity to analyze right triangles, develop an understanding of the statement of the Pythagorean theorem, and explain why the Pythagorean theorem holds. They apply the Pythagorean theorem to find distances between points on the coordinate plane and to find lengths of sides of a right triangle. In prior units, students learned to solve equations of type x^2 = p with (8-EE.2). In this unit, students apply this skill to solve Pythagorean equations.

Unit 4, Concept 1 Standards
- 8.G.A.7
- 8.G.A.6
- 8.G.A.5

Concept 2: Investigate the Pythagorean Theorem Converse

Concept Overview: Students learn that the measures of sides of a right triangle determine whether the triangle is a right triangle. They explain a proof of the converse of the Pythagorean theorem and apply the converse to solve real-world and mathematical problems.

Unit 4, Concept 2 Standards
- 8.G.B.6

Concept 3: Use the Pythagorean Theorem in 2-D and 3-D

Concept Overview: Students derive the distance formula from the Pythagorean theorem. They apply their understanding of the distance formula and the Pythagorean theorem to solve real-world and mathematical problems in 2-D and 3-D.

Unit 4, Concept 3 Standards
- 8.G.B.8
- 8.G.B.7

Unit 5: Scientific Notation

Unit Overview: Students will build on their knowledge of powers of 10 and writing multiplication expressions to estimate very large and very small quantities as a single digit multiplied by a power of 10. Then, they will extend this knowledge to discover and practice writing numbers in scientific notation and selecting the correct units of measure. Students will deepen their understanding of scientific notation and properties of exponents, and they will perform operations with numbers expressed in scientific notation in mathematical and real-world contexts.(Focus on MP.5, MP.7, MP.8)

Concept 1: Represent Large and Small Numbers

Concept Overview: Students use their prior knowledge of powers of 10 and writing multiplication expressions to estimate very large and very small quantities as a single digit multiplied by a power of 10. Then, they extend this knowledge to discover and practice writing numbers in scientific notation and selecting the correct units of measure.

Unit 5, Concept 1 Standards
- 8.EE.A.3
- 8.EE.A.4

Concept 2: Perform Operations Using Scientific Notation

Concept Overview: Students build on their understanding of scientific notation and properties of exponents to perform operations with numbers expressed in scientific notation in mathematical and real-world contexts.

Unit 5, Concept 2 Standards
- 8.EE.A.4

Unit 6: Intersecting Lines and Angles

Unit Overview: Students will study and describe the interior and exterior angles of a triangle, as well as develop the relationships among angles described by the angle sum theorem and the exterior angle theorem. They will use transformations to create parallel lines and to identify and apply the relationship between the lines and the angles formed when parallel lines are cut by a transversal. (Focus on MP.2, MP.3, MP.7)

Concept 1: Understand Interior and Exterior Angles

Concept Overview: Students investigate and describe the interior and exterior angles of a triangle, as well as develop the relationships among angles described by the angle sum theorem and the exterior angle theorem.

Unit 6, Concept 1 Standards
- 8.G.A.5

Concept 2: Investigate Parallel and Intersecting Lines

Concept Overview: Students use transformations to create parallel lines and to identify and apply the relationship between the lines and the angles formed when parallel lines are cut by a transversal.

Unit 6, Concept 2 Standards
- 8.G.A.1
- 8.G.A.1a
- 8.G.A.1b
- 8.G.A.5

Unit 7: Introduction to Functions

Unit Overview: Students will graph proportional relationships, interpreting the unit rate as the slope of the graph. They will explain the slope of the graph by means of similar triangles and derive the equation $y = mx$ or $y = mx + b$. They will explore characteristics of functions and determine when a table displays a rate of change characteristic of a linear function relationship. Additionally, students will develop mathematical models for rules that describe relationships between input and output values, and they will use a graphing calculator to create graphs used to distinguish between functions and non-functions. They will learn that when graphed, all linear relationships have a constant rate of change, which is the slope of the line, and can be described by the equation y= mx+b. Students will also learn the meaning of each variable when the relationship is represented verbally and graphically. Finally, they will understand how to translate functions presented in a table, equation, or graph into each of the other representations.(Focus on MP.2, MP.4, MP.8)

Concept 1: Represent Proportional Relationships

Concept Overview: Students graph proportional relationships, interpreting the unit rate as the slope of the graph. Students explain the slope of the graph by means of similar triangles and derive the equation $y = mx$ or $y = mx + b$. They then construct a function to model the linear relationship between the two quantities.

Unit 7, Concept 1 Standards
- 8.EE.B.5
- 8.F.A.3
- 8.F.B.4

Concept 2: Investigate Properties of Functions

Concept Overview: Students build on their previous knowledge of graphs and other representations of proportional relationship representations. They explore characteristics of functions and determine when a table displays a rate of change characteristic of a linear function relationship. Additionally, students develop mathematical models for rules that describe relationships between input and output values, and use a graphing calculator to create graphs used to distinguish between functions and non-functions. Students use what they have learned to match various representations of functions.

Unit 7, Concept 2 Standards
- 8.F.A.1
- 8.F.A.2
- 8.F.B.4
- 8.F.B.5

Concept 3: Understand Linear Functions

Concept Overview: Students learn that when graphed, all relationships have a constant rate of change, which is the slope of the line, and can be described by the equation y= mx+b. They also learn the meaning of each variable when the relationship is represented verbally and graphically. Students understand how to translate functions presented in a table, equation, or graph into each of the other representations.

Unit 7, Concept 3 Standards
- 8.EE.B.6
- 8.F.A.1
- 8.F.A.2
- 8.F.A.3
- 8.F.B.4
- 8.F.B.5
- 8.G.A.3

Concept 4: Graph, Describe, and Analyze Functions

Concept Overview: Through the Investigations in this concept, students build upon their understanding of linear relationships to distinguish between linear functions and non-linear functions. Students make distinctions using various representations of functions, including verbal descriptions, tables, equations, and graphs. Students understand the difference between linear and nonlinear functions in terms of rate of change and *x*-intercepts. Students apply these understandings to sketch graphs of linear and nonlinear functions given a verbal description.

Unit 7, Concept 4 Standards
- 8.F.A.1
- 8.F.A.2
- 8.F.A.3
- 8.F.B.5

Unit 8: Linear Relationships

Unit Overview: Students will solve linear equations using tables, graphs, and algebra. They construct functions to model linear relationships, analyze graphs to describe functional relationships, and examine the meaning of variables, including rate of change and initial value. Students will solve linear equations with rational number coefficients using algebra. They will explore linear equations with one, no, and infinite solutions, both graphically and algebraically.(Focus on MP.2, MP.4, MP.8)

Concept 1: Explore Linear Functions and Linear Equations

Concept Overview: Students build on their knowledge of linear equations to solve linear equations using tables, graphs, and algebra. They construct functions to model linear relationships, analyze graphs to describe functional relationships, and examine the meaning of variables, including rate of change and initial value.

Unit 8, Concept 1 Standards
- 8.F.B.5
- 8.F.B.4
- 8.EE.C.7b

Concept 2: Solve Linear Equations Algebraically

Concept Overview: Students broaden their understanding of solving linear equations with tables and graphs to solve linear equations with rational number coefficients using algebra. They explore linear equations with one, no, and infinite solutions, both graphically and algebraically.

Unit 8, Concept 2 Standards
- 8.EE.C.7
- 8.EE.C.7a
- 8.EE.C.7b

Unit 9: Linear Systems

Unit Overview: Students will explore methods for solving a system of equations algebraically (through substitution and elimination), graphically, and by inspection. They will develop an understanding that a system of equations can have one solution, infinite solutions, or no solution. (Focus on MP.1, MP.2, MP.4)

Concept 1: Model Situations with Multiple Equations

Concept Overview: Students learn how to represent situations with two variables using a system of equations. Students explore methods for solving a system of equations algebraically (through substitution and elimination), graphically, and by inspection. They develop an understanding that a system of equations can have one solution, infinite solutions, or no solution, and they can understand the meaning of the solution in context.

Unit 9, Concept 1 Standards
- 8.EE.C.8c
- 8.EE.C.8a
- 8.EE.C.8

Unit 10: Bivariate Data

Unit Overview: Students will expand upon their understanding of data displays to discover the type of data that is shown in a scatter plot. They will research, gather data, and set up scatter plots, looking for associations and drawing conclusions from positive, negative, and no associations shown on the plots. Students will make the extension from a dot plot with univariate data to a scatter plot with bivariate data. They will use scatter plots to show relationships between two data sets and then use a line of best fit for scatter plots that suggest a linear association. Students will build on their knowledge of bivariate data by constructing two-way tables and relative frequency tables. They will use the table to analyze data and draw conclusions, and they will describe possible associations between the data. (Focus on MP.1, MP.4, MP.8)

Concept 1: Create and Analyze Scatter Plots

Concept Overview: Students build on their knowledge of data displays to discover the type of data that is shown in a scatter plot. They research, gather data, and set up scatter plots, looking for associations and drawing conclusions from positive, negative, and no associations shown on the plots. Students make the extension from a dot plot with univariate data to a scatter plot with bivariate data. They use their previous work with interquartile range and outliers presented in box plots to analyze scatter plots and the associations represented.

Unit 10, Concept 2 Standards
- 8.SP.A.1
- 8.SP.A.2
- 8.SP.A.3
- 8.SP.A.4

Concept 2: Generate Lines of Best Fit

Concept Overview: Students focus on using scatter plots to show relationships between two data sets and then use a line of best fit for scatter plots that suggest a linear association. They use a line of best fit to solve problems, including prediction questions based on the data, and interpret slope and *y*-intercept in the context of the

Unit 10, Concept 2 Standards
- 8.SP.A.2
- 8.SP.A.3

problem.

Concept 3: Create and Analyze Two-Way Tables

Concept Overview: Students concentrate on their background of bivariate data to construct two-way tables and relative frequency tables. They use the tables to analyze data and draw conclusions, and they describe possible associations between the data.

Unit 10, Concept 3 Standards
- 8.SP.A.4

Unit 11: Volumes of Solid Figures

Unit Overview: Students will develop formulas for the volume of cylinders, cones, and spheres and use these formulas to solve problems. They will extend what they have learned about volume formulas when they use the formulas to solve for other variables, such as radius or base radius. Students will be able to solve equations by taking the square root or cube root of each side. (Focus on MP.1, MP.4, MP.8)

Concept 1: Investigate Volume Formulas

Concept Overview: Students build on what they have learned about volume and area as they develop formulas for the volume of cylinders, cones, and spheres and use these formulas to solve problems. Note that students apply their understanding of the area of a circle as they derive formulas for the volume of cylinders and cones. Students extend what they have learned about volume formulas when they use the formulas to solve for other variables, such as radius or base radius.

Unit 11, Concept 1 Standards
- 8.G.C.9