New Jersey Student Learning Standards for Mathematics and Student Learning Objectives

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Grade 8 – Exponents, Irrational Numbers, and Linear Equations – Unit 1

Rationale

Unit 1 introduces learners to the concept of irrational numbers, requiring them to classify numbers as either rational or irrational and approximate irrational expressions using rational numbers. The unit continues with the understanding and application of integer exponents and scientific notation. Learners not only know the properties of exponents, but also apply those properties to efficiently simplify and/or rewrite exponential expressions. With respect to scientific notation, learners perform simple mathematical operations with numbers written in scientific notation and make comparisons between two quantities by estimating numbers written in scientific notation. Learners solve linear equations in one variable, including using square root and cube root symbols to represent solutions to simple equations.

Grade 8 – Unit 1, Module A

Standard	Student Learning Objectives We are learning to … / We are learning that …
☐ **8.NS.A.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.	• numbers that are not rational are called irrational • every number has a decimal expansion • show that rational numbers have decimal expansions that either terminate in zeros or repeats eventually • convert a repeating decimal to a rational number
☐ **8.NS.A.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). *For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*	• estimate the value of irrational numbers using rational approximations • use rational approximations of irrational numbers to compare their size • use rational approximations of irrational numbers to locate them on a number line

Key: ■ Major Cluster   ☐ Supporting Cluster   ◯ Additional Cluster

New Jersey Student Learning Standards for Mathematics and Student Learning Objectives

Grade 8 – Unit 1, Module B

Standard	Student Learning Objectives We are learning to … / We are learning that …
■ **8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.*	▪ know the properties of integer exponents ▪ determine whether two numerical expressions involving integer exponents are equivalent ▪ generate equivalent expressions using the properties of exponents
■ **8.EE.A.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. *For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.*	▪ estimate a very large or very small number as a single digit times an integer power of ten ▪ express how many times larger one quantity is compared to another when written as a single digit times an integer power of ten
■ **8.EE.A.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.	▪ add, subtract, multiply, and divide numbers expressed in scientific notation ▪ add, subtract, multiply, and divide numbers where one is expressed in decimal notation and the other is expressed in scientific notation ▪ choose appropriate units to represent measurements of very large or very small quantities ▪ interpret scientific notation generated by technology as a number multiplied by a power of ten

Grade 8 – Unit 1, Module C

Standard	Student Learning Objectives We are learning to … / We are learning that …
■ **8.EE.C.7** Solve linear equations in one variable. 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). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.	▪ a linear equation in one variable can result in one solution, infinitely many solutions, or no solution ▪ show which of these outcomes is the case by transforming the original equation into the form $x = a$, $a = a$, or $a = b$ ▪ solve linear equations in one variable with rational number coefficients, including equations that require expanding expressions using the distributive property and combining like terms
■ **8.EE.A.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.	▪ use square root and cube root symbols to represent solutions to equations in the form $x^2 = p$ and $x^3 = p$ ▪ evaluate square roots of small perfect squares and cube roots of small perfect cubes ▪ $\sqrt{2}$ is an irrational number
◉ **8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.	▪ apply the formulas for volume of a cone, cylinder, or sphere in a real-world context ▪ calculate the volume of a cone, cylinder, or sphere ▪ find a missing dimension of a cone, cylinder or sphere given its volume

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New Jersey Student Learning Standards for Mathematics and Student Learning Objectives

Grade 8 – Pythagorean Theorem, Congruence and Similarity – Unit 2

Rationale

Unit 2 provides a continuation of solving linear equations as it pertains to the Pythagorean Theorem. Learners apply the Pythagorean Theorem to find unknown side lengths of right triangles in both two- and three-dimensional figures, and to find distances between coordinate points on a coordinate plane. The unit continues with an analysis of transformations (i.e. reflections, rotations, translations, and dilations) in which learners should develop an understanding of congruence and similarity. They understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations. They understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations. These understandings are then used to establish facts about the angle sum and exterior angle of triangles, the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.

Grade 8 – Unit 2, Module A

Standard	Student Learning Objectives We are learning to … / We are learning that …
■ **8.G.B 6** Explain a proof of the Pythagorean Theorem and its converse.	▪ the Pythagorean Theorem states that the square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides ▪ explain a proof of the Pythagorean Theorem ▪ explain a proof of the converse of the Pythagorean Theorem
■ **8.G.B.8** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	▪ apply the Pythagorean Theorem to find the distance between two points in a coordinate system
■ **8.G.B.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	▪ apply the Pythagorean Theorem to determine unknown side lengths in right triangles in two-dimensional figures ▪ apply the Pythagorean Theorem to determine unknown side lengths in right triangles in three-dimensional figures ▪ apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world problems

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Grade 8 – Unit 2, Module B

Standard	Student Learning Objectives We are learning to … / We are learning that …

■ **8.G.A.1** Verify experimentally the properties of rotations, reflections, and translations:
    a. Lines are transformed to lines, and line segments to line segments of the same length.
    b. Angles are transformed to angles of the same measure.
    c. Parallel lines are transformed to parallel lines.
	▪ verify that when a reflection, rotation, and/or translation is performed, lines are transformed to lines, and line segments to line segments of the same length
	▪ verify that when a reflection, rotation, and/or translation is performed, angles are transformed to angles of the same measure
	▪ verify that when a reflection, rotation, and/or translation is performed, parallel lines are transformed to parallel lines

■ **8.G.A.2** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.	▪ two figures are congruent if one can be obtained from the other by a sequence of rotations, reflections, and/or translations ▪ describe a sequence of transformations that maps one congruent figure onto another
■ **8.G.A.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.	▪ dilate, translate, rotate, and reflect two-dimensional figures on a coordinate plane ▪ describe the effects of dilations, translations, rotations, and reflections using coordinates
■ **8.G A.4** Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.	▪ two figures are similar if one can be obtained from the other by a sequence of dilations and rotations, reflections, and/or translations ▪ describe a sequence of transformations that maps one similar figure onto another
■ **8.G.A.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. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*	▪ the sum of the interior angles of a triangle is 180 degrees ▪ the measure of an exterior angle of a triangle is equal to the sum of the two remote interior angles ▪ when parallel lines are cut by a transversal, corresponding, alternate interior, and alternate exterior angles are congruent ▪ if two sets of corresponding angles in two triangles are congruent, then the triangles are similar ▪ use facts about angles to construct an informal argument

Grade 8 – Linear Relationships and Functions – Unit 3

Rationale

Unit 3 introduces learners to the idea of a function as a precursor to concepts about functions that are included in the high school standards. Learners begin the unit describing qualitatively the relationship between two quantities by analyzing a graph as an informal introduction to functions. They describe a function more formally by identifying it as a rule that assigns to each input exactly one output. In this unit, the concepts developed in grades 6 and 7 such as modeling relationships with variables and equations and ratio and proportional reasoning, are used to make connections between proportional relationships, lines, and linear equations. Learners graph linear functions, construct a function to model a linear relationship, interpret the rate of change and initial value of a linear function in a real-world context, and compare linear functions presented in different ways. The unit concludes with analyzing and solving pairs of simultaneous linear equations. Learners solve systems of linear equations algebraically, and solve real-world mathematical problems leading to two linear equations in two variables.

Grade 8 – Unit 3, Module A

Standard	Student Learning Objectives We are learning to … / We are learning that …
■ **8.F.A.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.	▪ 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
■ **8.F.B.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.	▪ describe qualitatively the functional relationships between two quantities by analyzing a graph ▪ sketch a graph that exhibits the qualitative features of a function given a verbal description
■ **8.F.A.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. *For example, the function A = s² giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.*	▪ the equation $y = mx + b$ defines a linear function ▪ interpret a set of points forming a straight line as the graph of a linear function ▪ graph linear equations ▪ give examples of nonlinear functions

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Grade 8 – Unit 3, Module B

Standard	Student Learning Objectives We are learning to … / We are learning that …
■ **8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*	▪ graph proportional relationships represented in different ways (i.e. ordered pairs, table, equation, phrases, etc.) ▪ recognize that for proportional relationships, the unit rate is the slope of the graph ▪ compare the unit rates of two proportional relationships represented in different ways
■ **8.EE.B.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.	▪ explain why the slope is the same between any two distinct points on a non-vertical line by drawing similar right triangles and comparing the ratios of their sides ▪ derive the equation $y = mx$ for a line through the origin ▪ derive the equation $y = mx + b$ for a line intercepting the y-axis at b
■ **8.F.B.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.	▪ construct a function to model a linear relationship between two quantities ▪ determine the rate of change and initial value of a 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 function in terms of the situation it models
■ **8.F.A.2** Compare properties (e.g. rate of change, intercepts, domain and range) of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*	▪ compare properties such as rate of change, intercepts, domain and range of two functions each represented in a different way

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Grade 8 – Unit 3, Module C

Standard	Student Learning Objectives We are learning to … / We are learning that …
■ **8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6. c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*	▪ solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs ▪ points of intersection satisfy both equations simultaneously ▪ solve systems of two linear equations in two variables algebraically ▪ estimate solutions of two linear equations in two variables by graphing the equations ▪ determine the number of solutions a system of two linear equations will have based upon inspection ▪ solve a system of two linear equations modeling real-world and mathematical problems

Grade 8 – Linear Models for Scatter Plots and Two-Way Tables – Unit 4

Rationale

Unit 4 provides a continuation of the analysis of linear models as they pertain to bivariate data. Learners investigate patterns of association in bivariate data using scatter plots and two-way tables, including informally fitting and assessing the fit of a linear model for a scatter plot, interpreting the slope and intercept of a linear model in the context of bivariate data, and using joint and relative frequencies of a two-way table to describe possible association between two variables.

Grade 8 – Unit 4, Module A

Standard	Student Learning Objectives We are learning to … / We are learning that …
☐ **8.SP.A.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.	▪ construct scatter plots ▪ interpret scatter plots to investigate patterns of association between two quantities ▪ describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association
☐ **8.SP.A.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 (e.g. line of best fit) by judging the closeness of the data points to the line.	▪ straight lines are used to model relationships between two quantitative variables ▪ informally fit a straight line for scatter plots that suggest a linear association ▪ informally assess the fit of the line for a scatter plot by judging the closeness of the data points to the line
☐ **8.SP.A.3** Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*	▪ interpret the slope and intercept in the context of bivariate measurement data using the equation of a linear model

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☐ **8.SP.A.4** Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*	▪ two-way tables can be used to show patterns of association in categorical data ▪ construct a two-way table summarizing data on two categorical variables collected from the same subjects ▪ interpret a two-way table by identifying joint frequencies and calculating marginal frequencies ▪ use relative frequencies calculated for rows or columns to describe possible association between the two variables