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STATE OF NEW JERSEY
DEPARTMENT OF EDUCATION

Algebra 1: New Jersey Student Learning Standards for Mathematics - Prerequisite Standards and Learning Objectives by Domain

Description

Included here are the prerequisite concepts and skills necessary for students to learn grade level content based on the New Jersey Student Learning Standards in mathematics. This tool is intended to support educators in the identification of any gaps in conceptual understanding or skill that might exist in a student's understanding of mathematics standards. The organization of this document mirrors that of the New Jersey Student Learning Standards for mathematics, includes all grade- or course-level standards and the associated student learning objectives, and reflects a grouping of the standards by conceptual category and domain.

The tables are divided into two columns. The first column contains the grade level standard and student learning objectives, which reflect the corresponding concepts and skills in that standard. The second column contains standards from prior grades and the corresponding learning objectives, which reflect prerequisite concepts and skills essential for student attainment of the grade level standard as listed in the first column. Given that a single standard may reflect multiple concepts and skills, all learning objectives for a prior grade standard may not be listed. Only those prior grade learning objectives that reflect prerequisite concepts and skills important for attainment of the associated grade level standard is listed.

Content Emphases Key: ■: Major Cluster ▣: Supporting Cluster ◎: Additional Cluster

Note: Double asterisks (**) indicate that the example(s) included within the New Jersey Student Learning Standard may be especially informative when considering the Student Learning Objective.

Algebra 1: New Jersey Student Learning Standards for Mathematics - Prerequisite Standards and Learning Objectives

Algebra – Seeing Structure in Expressions (A.SSE)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
A.SSE.A.1 Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example*, interpret $P(1+r)^n$ as the product of P and a factor not depending on P. We are learning to/that… ▪ interpret parts of an expression, such as terms, factors, and coefficients, in context ▪ interpret the meaning of a complicated expression by viewing one or more parts as a single quantity	**7.EE.A.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. *For example*, $a + 0.05a = 1.05a$ means that “increase by 5%” is the same as “multiply by 1.05.” We have learned to/that… ▪ rewriting an expression in different forms can clarify the problem and how the quantities are related **6.EE.A.2** Write, read, and evaluate expressions in which letters stand for numbers. b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example*, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms. We have learned to/that… ▪ identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient) ▪ view one or more parts of an expression as a single entity
A.SSE.A.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 $(x^2 − y^2)(x^2 + y^2)$. We are learning to/that… ▪ use the structure of an expression to identify ways to rewrite it	**7.EE.A.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. We have learned to/that… ▪ apply the properties of operations as strategies to **add, subtract**, factor, and **expand** linear expressions with rational coefficients **6.EE.A.3** Apply the properties of operations to generate equivalent expressions. *For example*, apply the distributive property to the expression $3(2 + x)$ to produce the equivalent expression $6 + 3x$; apply

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
	the distributive property to the expression $24x + 18y$ to produce the equivalent expression $6(4x + 3y)$; apply properties of operations to $y + y + y$ to produce the equivalent expression $3y$. We have learned to/that… ▪ generate equivalent expressions using the properties of operations
A.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. We are learning to/that… ▪ factor a quadratic expression in order to reveal the zeros of the function it defines ▪ complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines	**7.EE.A.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. We have learned to/that… ▪ apply the properties of operations as strategies to add, subtract, **factor**, and expand linear expressions with rational coefficients
A.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. c. Use the properties of exponents to transform expressions for exponential functions. *For example:* the expression 1.15^t can be rewritten as $(1.15)^{1/12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%. We are learning to/that… ▪ use the properties of exponents to rewrite exponential expressions the define an exponential function in order to reveal information in the context of the problem or situation	**8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example*, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$. We have learned to/that… ▪ know the properties of integer exponents ▪ determine whether two numerical expressions involving integer exponents are equivalent ▪ generate equivalent expressions using the properties of exponents

Algebra – Arithmetic with Polynomials and Rational Functions (A.APR)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
A.APR.A.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. We are learning to/that… ▪ polynomials form a system comparable to the integers ▪ the sum, difference, and product of two polynomials is a polynomial ▪ add and subtract polynomials ▪ multiply polynomials	**8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example*, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$. We have learned to/that… ▪ know the properties of integer exponents ▪ determine whether two numerical expressions involving integer exponents are equivalent **7.EE.A.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. We have learned to/that… ▪ apply the properties of operations as strategies to **add, subtract**, factor, and **expand** linear expressions with rational coefficients **6.EE.A.3** Apply the properties of operations to generate equivalent expressions. *For example*, apply the distributive property to the expression $3(2 + x)$ to produce the equivalent expression $6 + 3x$; apply the distributive property to the expression $24x + 18y$ to produce the equivalent expression $6 (4x + 3y)$; apply properties of operations to $y + y + y$ to produce the equivalent expression $3y$. We have learned to/that… ▪ generate equivalent expressions using the properties of operations **6.EE.A.4** Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example*, the expressions $y + y + y$ and $3y$ are equivalent because they name the same number regardless of which number y stands for.

Algebra 1: New Jersey Student Learning Standards for Mathematics - Prerequisite Standards and Learning Objectives

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
	We have learned to/that… ▪ two expressions are equivalent when they name the same number regardless of which value is substituted into them ▪ identify when two expressions are equivalent
A.APR.B.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. We are learning to/that… ▪ identify the zeros of a polynomial function when suitable factorizations are available ▪ use the zeros to construct a rough graph of the function defined by the polynomial	**7.EE.A.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. We have learned to/that… ▪ apply the properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients

Algebra – Creating Equations (A.CED)

<table>
<tr><th>Standard and Student Learning Objectives</th><th>Previous Grade(s) Standards and Student Learning Objectives</th></tr>
<tr><td>A.CED.A.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

We are learning to/that…
▪ create linear equations and inequalities in one variable to model a problem or situation
▪ use linear equations and inequalities to solve problems
▪ create exponential equations and inequalities in one variable to model a problem or situation
▪ create quadratic equations in one variable to model a problem or situation
▪ use quadratic equations in one variable to solve problems</td><td>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.

We have learned to/that…
▪ 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

7.EE.B.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.

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. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?

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. For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100.</td></tr>
</table>

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
	Write an inequality for the number of sales you need to make and describe the solutions. We have learned to/that… ▪ solve word problems by reasoning about their quantities and constructing simple equations of the form $p(x + q) = r$, where p, q, and r are specific rational numbers ▪ solve equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers ▪ solve word problems by reasoning about their quantities and constructing simple inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers
A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. We are learning to/that… ▪ create *linear* equations to represent relationships between two or more quantities ▪ graph *linear* equations on the coordinate plane to represent relationships	**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 $A = s^2$ 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. We have learned to/that… ▪ graph linear equations. **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. We have learned to/that… ▪ construct a function to model a linear relationship between 2 quantities.

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
	■ **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. We have learned to/that… ▪ graph proportional relationships represented in different ways ■ **7.RP.A.2** Recognize and represent proportional relationships between quantities. c. Represent proportional relationships by equations. *For example*, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn. We have learned to/that… ▪ represent proportional relationships by equations using the constant of proportionality (unit rate)
■ **A.CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example*, represent inequalities describing nutritional and cost constraints on combinations of different foods. We are learning to/that … ▪ constraints reflect conditions in the modeling process ▪ represent a constraint as an equation or inequality ▪ represent constraints by a system of equations in the modeling context	■ **7.EE.B.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. 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. *For example*, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
▪ represent constraints by a system of inequalities in the modeling context ▪ interpret possible solutions as viable or nonviable in the modeling context	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. *For example:* As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make and describe the solutions. We have learned to/that… ▪ solve word problems by reasoning about their quantities and constructing simple equations of the form $p(x + q) = r$, where p, q, and r are specific rational numbers ▪ solve word problems by reasoning about their quantities and constructing simple inequalities of the form $px + q > r$ *or* $px + q < r$, where p, q, and r are specific rational numbers ▪ use variables to represent unknown quantities in mathematical problems to construct and solve simple inequalities
■ **A.CED.A.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example*, rearrange Ohm's law $V = IR$ to highlight resistance R. We are learning to/that … ▪ rearrange formulas to isolate a variable of interest, using the same reasoning as in solving equations	

Algebra – Reasoning with Equations and Inequalities (A.REI)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
A.REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. We are learning to/that… ▪ explain each step in solving a simple equation, assuming it has a solution ▪ construct viable arguments to justify a solution method	n/a
A.REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. We are learning to/that… ▪ solve linear equations and inequalities in one variable ▪ solve one-variable linear equations that have coefficients represented by letters	**8.EE.C.7** Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. We have learned to/that… ▪ solve linear equations in one variable with rational number coefficients, including equations that require expanding expressions using the distributive property and combining like terms.
A.REI.B.4 Solve quadratic equations in one variable. 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. 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 $a \pm bi$ for real numbers a and b.	**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. We have learned to/that… ▪ use square root and cube root symbols to represent solutions to equations in the form $x^2 = p$ and $x^3 = p$

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
We are learning to/that… ▪ solve quadratic equations by completing the square ▪ use completing the square to rewrite a quadratic equation in the form $(x - p)^2 = q$ ▪ use the form $(x - p)^2 = q$ to derive the quadratic formula ▪ solve quadratic equations by using the quadratic formula ▪ recognize, using the discriminant, when the quadratic formula gives complex solutions and write them as $a \pm bi$	▪ evaluate square roots of small perfect squares and cube roots of small perfect cubes ▪ $\sqrt{2}$ is an irrational number **8.EE.C.7** Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. We have learned to/that… ▪ solve linear equations in one variable with rational number coefficients, including equations that require expanding expressions using the distributive property and combining like terms
A.REI.C.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. We are learning to/that… ▪ transform a system of two equations in two variables into simpler forms that produce a system with the same solutions ▪ prove that through elimination, the transformed system will produce the same solution as the original system	**8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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 We are learning to/that… ▪ solve systems of two linear equations in two variables algebraically.
A.REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. We are learning to/that… ▪ solve a system of linear equations in two variables exactly and approximately	**8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
	We are learning to/that… ▪ solve systems of two linear equations in two variables algebraically. ▪ estimate solutions of two linear equations in two variables by graphing the equations.
A.REI.D.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). We are learning to/that… ▪ understand that the graph of an equation, in two variables, is the set of all solutions, often forming a curve	n/a
A.REI.D.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, polynomial, rational, absolute value, exponential, and logarithmic functions We are learning to/that… ▪ in cases where $f(x)$ and/or $g(x)$ are linear, polynomial, absolute value, and exponential, explain why the *x*-coordinate of the point of intersection of graphs of $f(x)$ and $g(x)$ is the solution of the equation $f(x) = g(x)$ ▪ in cases where cases where $f(x)$ and/or $g(x)$ are linear, polynomial, absolute value, and exponential, find approximate solutions using technology to graph the functions, make tables, and find successive approximations in order to find the solution of the equation $f(x) = g(x)$	**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. We have learned to/that… ▪ 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

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<tr><td>■ A.REI.D.12 Graph the solutions to a linear inequality in two variables as a half plane (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.

We are learning to/that…
▪ graph the solution of a linear inequality in two variables as a half plane
▪ graph a system of inequalities in two variables
▪ graph the solution set to a system of linear inequalities as the intersection of the two shaded regions</td><td>■ 7.EE.B.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.

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. For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make and describe the solutions.

We have learned to/that…
▪ describe the solution of an inequality using a graph and inequality statement and interpret its meaning in the context of the problem</td></tr>
</table>

Algebra 1: New Jersey Student Learning Standards for Mathematics - Prerequisite Standards and Learning Objectives

Functions – Interpreting Functions (F.IF)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
F.IF.A.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*). We are learning to/that… ▪ the domain is the set of all possible input values and the range is the set of all possible output values ▪ in a function, each element of the domain is assigned to exactly one element in the range ▪ *f*(*x*) denotes the output for a given input value of x, for a function *f* ▪ the graph of a f is equivalent to the graph of *y* = *f*(*x*)	**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. We have learned to/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 **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 We have learned to/that… ▪ compare properties such as domain and range of two functions each represented in a different way
F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. We are learning to/that… ▪ use function notation to find range values for inputs from a function's domain ▪ interpret statements that use function notation in terms of a context	**6.EE.A.2** Write, read, and evaluate expressions in which letters stand for numbers. 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, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). We have learned to/that… evaluate expressions, including formulas, for specific values of the variables

<table>
<tr><th>Standard and Student Learning Objectives</th><th>Previous Grade(s) Standards and Student Learning Objectives</th></tr>
<tr><td>■ F.IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n + 1) = f(n) + f(n - 1)$ for $n \geq 1$.

We are learning to/that…
▪ sequences are functions, sometimes defined recursively, whose domain is a subset of the integers
▪ construct arithmetic sequences given a graph, a description of a relationship, or two input-output pairs (include reading these from a table)
▪ construct geometric sequences given a graph, a description of a relationship, or two input-output pairs (include reading these from a table)</td><td>n/a</td></tr>
<tr><td>■ F.IF.B.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.

We are learning to/that…
▪ the key features of a graph include intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior
▪ sketch linear and exponential graphs showing key features of a relationship between two quantities given a verbal description of the relationship
▪ interpret key features of graphs and tables that model a linear or exponential relationship between two quantities in the context of those quantities</td><td>■ 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.

We have learned to/that…
▪ 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 $A = s^2$ 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.</td></tr>
</table>

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
▪ for functions that model a *quadratic* relationship, interpret key features of graphs and tables in the context of the problem ▪ sketch graphs of a *quadratic* functions, showing key features given a verbal description of the relationship	We have learned to/that… ▪ the equation $y = mx + b$ defines a linear function ▪ graph linear equations
F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example*, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.★ We are learning to/that… ▪ relate the domain of a function to its graph ▪ relate the domain of a function to the quantitative relationship it describes in the context of the problem or situation	n/a
F.IF.B.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. We are learning to/that… ▪ calculate the average rate of change of *linear and exponential* functions, presented as a table, over a specified interval and interpret it in the context of the problem ▪ estimate the average rate of change of *linear and exponential* functions from a graph and interpret it in the context of the problem ▪ calculate the average rate of change of *linear and exponential* function, presented symbolically, over a specified interval and interpret it in the context of the problem ▪ calculate the average rate of change of a *quadratic* function, represented as a table of values, over a specified interval and interpret it in the context of the problem	**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. We have learned to/that… ▪ 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

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
▪ estimate the average rate of change of a *quadratic* function, represented by a graph, over a specified interval and interpret it in the context of the problem ▪ calculate the average rate of change of a *quadratic* function, defined by an expression, over a specified interval and interpret it in the context of the problem	
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. We are learning to/that… ▪ graph quadratic functions expressed symbolically and show intercepts, maxima or minima	**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 $A = s^2$ 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. We have learned to/that… ▪ give examples of nonlinear functions
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. We are learning to/that… ▪ graph square root, cube root, and show key features of the graph ▪ graph piecewise-defined functions, including step functions and absolute value functions, and show key features of the graph	**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. We have learned to/that… ▪ 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.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 $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
	contains the points (1,1), (2,4) and (3,9), which are not on a straight line. We have learned to/that… ▪ 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
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.) c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior We are learning to/that… ▪ identify the zeros of a polynomial function when suitable factorizations are available ▪ graph polynomial functions showing end behavior	**7.EE.A.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. We have learned to/that… ▪ apply the properties of operations as strategies to add, subtract, **factor**, and expand linear expressions with rational coefficients
F.IF.C.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. We are learning to/that… ▪ graph exponential functions, showing intercepts and end behavior of the graph	n/a

Algebra 1: New Jersey Student Learning Standards for Mathematics - Prerequisite Standards and Learning Objectives

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
F.IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal; explain different properties of the function. 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. We are learning to/that… ▪ use the process of factoring in a quadratic function to show and interpret the zeros of the function in the context of the problem ▪ use the process of completing the square in a quadratic function to show extreme values and symmetry of the graph and interpret these in the context of the problem.	**7.EE.A.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. We have learned to/that… ▪ apply the properties of operations as strategies to add, subtract, **factor**, and expand linear expressions with rational coefficients
F.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example*, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. We are learning to/that… ▪ compare properties of two *exponential* functions each represented in different ways (numerically, graphically, algebraically, or verbally) ▪ compare properties of two *quadratic* functions each represented in different ways (numerically, graphically, algebraically, or verbally)	**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. We have learned to/that… compare properties such as rate of change, intercepts, domain and range of two functions each represented in a different way

Functions – Building Functions (F.BF)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
F.BF.A.1 Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. We are learning to/that… ▪ write a function that describes a linear relationship between two quantities ▪ write a function that describes an exponential relationship between two quantities ▪ determine an explicit expression for a function that models a linear or exponential relationship between two quantities ▪ determine a recursive process for a function that model a linear or exponential relationship between two quantities ▪ determine a set of steps for calculation for a function that models a linear of exponential relationship between two quantities	**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. We have learned to/that… ▪ construct a function to model a linear relationship between two quantities. ▪ interpret the rate of change and initial value of a function in terms of the situation it models
F.BF.B.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. 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 We are learning to/that… ▪ identify the effect on the graph of *linear and exponential* functions by replacing $f(x)$ by $f(x) + k$ and $f(x + k)$ for specific values of k, and illustrate an explanation of the effects on the graph using technology	n/a

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
▪ identify the effect on the graph of *linear and exponential* functions by replacing $f(x)$ by $kf(x)$ and $f(kx)$ for specific values of k, and illustrate an explanation of the effects on the graph using technology ▪ find the value of k given graphs of *linear and exponential* functions ▪ identify the effect on the graph of *quadratic* functions by replacing $f(x)$ by $f(x) + k$ and $f(x + k)$ for specific values of k, and illustrate an explanation of the effects on the graph using technology ▪ identify the effect on the graph of *quadratic* functions by replacing $f(x)$ by $kf(x)$ and $f(kx)$ for specific values of k, and illustrate an explanation of the effects on the graph using technology ▪ find the value of k given graphs of *quadratic* functions ▪ experiment with all cases, $f(x) + k$, $f(x + k)$, $kf(x)$ and $f(\mathrm{k}x)$, and illustrate an explanation of the effects on the graph using technology ▪ recognize even and odd functions from their graphs and algebraic expressions for them	

Functions – Linear, Quadratic and Exponential Models (F.LE)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
F.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. We are learning to/that… ▪ recognize situations in which one quantity changes at a constant rate per unit interval relative to another (linear relationships) ▪ recognize situations in which a quantity grows or decays by a constant percent (exponential relationships) ▪ distinguish between situations that can be modeled with linear functions and with exponential functions ▪ prove that a function is linear by showing that the first differences are equal ▪ prove that a function is exponential by showing that the function grows by equal factors over equal intervals	**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 $A = s^2$ 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. We have learned to/that… ▪ graph linear equations. ▪ give examples of nonlinear functions **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. We have learned to/that… ▪ construct a function to model a linear relationship between two quantities.
F.LE.A.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). We are learning to/that… ▪ construct linear functions given a graph, a description of a relationship, or two input-output pairs (include reading these from a table)	**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. We have learned to/that…

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
▪ construct exponential functions, including geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table) ▪ construct arithmetic sequences given a graph, a description of a relationship, or two input-output pairs (include reading these from a table) ▪ construct geometric sequences given a graph, a description of a relationship, or two input-output pairs (include reading these from a table)	▪ 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
□ **F.LE.A.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. We are learning to/that… ▪ use a graph and a table to observe that a quantity that increases exponentially eventually exceeds a quantity that increases linearly ▪ use graphs and tables to observe that a quantity that increases exponentially eventually exceeds a quantity that increases quadratically	n/a
□ **F.LE.B.5** Interpret the parameters in a linear or exponential function in terms of a context. We are learning to/that… ▪ interpret the parameters (slope and constant term) of a linear function in terms of a context ▪ interpret the parameters (vertical intercept and base) of exponential function in terms of a context	n/a

Algebra 1: New Jersey Student Learning Standards for Mathematics - Prerequisite Standards and Learning Objectives

Number and Quantity – The Real Number System (N.RN)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
N.RN.B.3 Explain why the sum or product of two rational numbers is 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. We are learning to/that… ▪ explain why the sum and product of two rational numbers is rational ▪ explain that the sum of a rational number and irrational number is irrational ▪ explain that the product of a nonzero rational number and irrational number is irrational	**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. We have learned to/that… ▪ numbers that are not rational are called irrational.

Number and Quantity – Quantities (N.Q)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; Choose and interpret units consistently in formulas; Choose and interpret the scale and the origin in graphs and data displays. We are learning to/that… ▪ use units as a way to understand problems and to guide the solution of multi-step problems ▪ interpret units consistently in formulas ▪ choose and interpret the scale and the origin in graphs	n/a
N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. We are learning to/that … ▪ define appropriate quantities to be used in descriptive modeling	n/a
N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. We are learning to/that… ▪ choose an appropriate level of accuracy based on the limitations on measurement	**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. We have learned to/that… ▪ choose appropriate units to represent measurements of very large or very small quantities.

Statistics and Probability – Interpreting Categorical and Quantitative Data (S.ID)

Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). We are learning to/that… ▪ represent data using dot plots on the real number line ▪ represent data using histograms on the real number line ▪ represent data using box plots on the real number line	**6.SP.B.4** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. We have learned to/that… ▪ display numerical data in plots on a number line, including dot plots, histograms, and box plots
S.ID.A.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. We are learning to/that… ▪ compare the center (mean, median) and spread (interquartile range, standard deviation) of two or more different data sets using measures appropriate to the shape of the data	**6.SP.A.2** Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape**.** We have learned to/that… ▪ a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape **6.SP.B.5** Summarize numerical data sets in relation to their context, such as by: 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 from the overall pattern with reference to the context in which the data were gathered. We have learned to/that… ▪ describe overall patterns and any striking deviations from a data set by giving the measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation) with reference to the context with which the data was collected

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S.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

We are learning to/that…
▪ interpret differences in shape, center, and spread in the context of data sets
▪ interpret the effect of outliers on the shape, center, and spread of a data set
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6.SP.B.5 Summarize numerical data sets in relation to their context, such as by:

d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

We have learned to/that…
▪ the shape of the data distribution and the context in which the data were gathered can be related to the choice of measures of center and variability
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S.ID.B.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 conditional relative frequencies). Recognize possible associations and trends in the data.

We are learning to/that…
▪ summarize categorical data for two categories in a two-way frequency table
▪ interpret relative frequencies, including joint, marginal, and conditional relative frequencies, in the context of the data
▪ recognize possible associations and trends in categorical data
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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?

We have learned to/that…
▪ 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
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S.ID.B.6 Represent data on two quantitative variables on a scatter plot and describe how the variables are related.

a. Fit a function to the data (including with the use of technology); 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.
b. Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.
c. Fit a linear function for a scatter plot that suggests a linear association.

We are learning to/that…

- represent constraints by a system of equations in the modeling
- represent data on two quantitative variables on a scatterplot
- describe the relationship between the two sets of quantitative data
- fit linear and exponential functions to data by hand and with the use of technology
- use a function fitted to data to solve problems in the context of the data
- use given functions or choose a function suggested by the context.
- assess the fit of a function by plotting and analyzing residuals, including with the use of technology

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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.

We are learning to/that…

- 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.

We are learning to/that…

- 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

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

We are learning to/that…

- interpret the slope of a linear model as a constant rate of change in context of the data
- interpret the constant term of a linear model in context of the data

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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.

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Standard and Student Learning Objectives	Previous Grade(s) Standards and Student Learning Objectives
	We are learning to/that… ▪ interpret the slope and intercept in the context of bivariate measurement data using the equation of a linear model
S.ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. We are learning to/that… ▪ compute (using technology) and interpret the correlation coefficient for a linear fit	n/a
S.ID.C.9 Distinguish between correlation and causation. We are learning to/that… ▪ distinguish between correlation and causation	n/a