

# Algebra 1

## U-46 Curriculum Scope and Sequence

Reporting Strand	Instructional Focus	CCSS	Pacing
<b>Foundations of Algebra</b>	1.1/1.2/1.3 Analyze and apply expressions and equations	<b><u>A.SSE.1</u></b> , <b><u>A.CED.1</u></b>	5 weeks
	2.1 Solve equations and inequalities	<b><u>A.CED.1</u></b> , A.REI.1, <b><u>A.REI.3</u></b>	
	2.2 Rewrite literal equations	<b><u>A.CED.4</u></b> , <b><u>A.REI.3</u></b>	
	2.3 Solve absolute value equations and inequalities	A.REI.3, A.CED.3	
<b>Functions</b>	3.1 Understand and interpret functions	<b><u>F.IF.1</u></b> , <b><u>F.IF.2</u></b>	6 weeks
	3.2/3.3 Analyze sequences and functions	<b><u>F.BF.1a</u></b> , F.BF.2, F.IF.3, F.LE.1, F.IF.6, <b><u>F.LE.2</u></b> , F.LE.3	
	4.1/4.2 Analyze and compare graphs of linear and exponential functions	<b><u>F.IF.4</u></b> , <b><u>F.IF.5</u></b> , F.IF.6, <b><u>F.IF.9</u></b> , F.LE.3, A.REI.10, F.LE.5	
<b>Systems of Equations &amp; Inequalities</b>	5.1 Solve systems of equations	<b><u>A.REI.6</u></b> , <b><u>A.CED.2</u></b> , A.CED.4, A.REI.5, A.REI.11	4 weeks
	5.1/5.2 Solve and use systems of inequalities in decision making	<b><u>A.REI.12</u></b> , <b><u>A.CED.3</u></b> , A.CED.4	
<b>Exponents &amp; Exponential Functions</b>	7.3 Investigate rational exponents	N.RN.1, <b><u>N.RN.2</u></b> , A.SSE.3c	4 weeks
	8.1 Represent exponential functions	F.BF.1, F.BF.3, <b><u>F.IF.4</u></b> , <b><u>F.IF.5</u></b> , F.IF.6	
	8.2 Analyze growth and decay models	<b><u>A.CED.2</u></b> , <b><u>A.SSE.1b</u></b> , A.REI.11, F.IF.7e, <b><u>F.IF.8b</u></b> , <b><u>F.LE.1c</u></b> , <b><u>F.LE.5</u></b> , A.SSE.3c	
<b>Polynomials</b>	9.1 Perform operations on polynomials	<b><u>A.APR.1</u></b> , A.SSE.1	4 weeks
	9.2 Factor polynomials	<b><u>A.SSE.2</u></b> , A.SSE.1	
<b>Quadratic Functions</b>	10.1/10.2 Solve quadratic equations	<b><u>A.REI.4</u></b> , N.RN.3	4 weeks
	10.2 Analyze quadratic functions	<b><u>F.IF.8a</u></b> , <b><u>A.SSE.3</u></b>	
<b>Graphs of Non-Linear Functions</b>	11.1 Analyze graphs of quadratics	<b><u>F.IF.4</u></b> , <b><u>F.IF.5</u></b> , <b><u>F.IF.7a</u></b> , <b><u>F.IF.8a</u></b> , F.IF.9, A.CED.1, F.BF.1, F.BF.3	5 weeks
	7.1 Create and analyze non-linear functions	A.CED.2, <b><u>F.IF.7b</u></b>	
	7.2 Transformations of non-linear functions	<b><u>F.BF.3</u></b>	
<b>Descriptive Statistics</b>	6.1 Represent and analyze data	S.ID.1, S.ID.2, <b><u>S.ID.3</u></b>	4 weeks
	6.2 Analyze scatter plots	<b><u>S.ID.6</u></b> , <b><u>S.ID.7</u></b> , S.ID.8, S.ID.9	
	6.3 Interpret two-way frequency tables	<b><u>S.ID.5</u></b>	

Standards that are **bolded and underlined** are the essential “power standards”.

## Foundations of Algebra

### Analyze and apply expressions and equations (1.1/1.2/1.3)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Interpret expressions and equations</b> (A.SSE.1*)	Can extend thinking beyond the standard, including tasks that may involve one of the following:	Interpret individual <b>and groups</b> of parts of an expression (such as variables, coefficients, factors, etc.) in terms of a given context	<b>Identify groups in an expression and Interpret</b> individual parts of an expression (such as variables, coefficients, factors, etc.) <b>in terms of a given context</b>	<b>Identify</b> individual parts of an expression (such as variables, coefficients, factors, etc.)	Little evidence of reasoning or application to solve the problem
<b>Create expressions and equations</b> (A.CED.1*)	<ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Create linear equations with one variable and use them in a contextual situation <b>and solve problems.</b>	<b>Create</b> linear equations with one variable and use them in a contextual situation	<b>Identify</b> linear equations with one variable to represent a contextual situation	Does not meet the criteria in a level 1

A.SSE.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.

A.CED.1\* Create equations and inequalities in one variable and use them to solve problems

## Foundations of Algebra

### Solve equations and inequalities (2.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Solve equations and inequalities</b> (A.REI.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following:	Solve linear equations and inequalities with rational numbers and variables on both sides, that requires distributing <b>and</b> combining like terms.	Solve linear equations and inequalities with rational numbers and variables on both sides, <b>that requires distributing or combining like terms.</b>	Solve linear equations and inequalities with rational numbers and <b>variables on both sides.</b>	Little evidence of reasoning or application to solve the problem
<b>Explain steps to solving</b> (A.REI.1)	<ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Explain each step in solving an equation using properties of equality <b>and justify the solution method</b>	<b>Explain</b> each step in solving an equation using properties of equality.	<b>Identify</b> /match properties of equality used for each step in solving an equation.	Does not meet the criteria in a level 1
<b>Create equations and inequalities</b> (A.CED.1*)		Create linear equations <b>and</b> inequalities with one variable and use them in a contextual situation and solve problems.	<b>Create</b> linear equations or inequalities with one variable and use them in a contextual situation and solve problems.	<b>Identify</b> linear equations <b>or</b> inequalities with one variable to represent a contextual situation and use them to solve problems.	

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

A.REI.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.

A.CED.1\* Create equations and inequalities in one variable and use them to solve problems

## Foundations of Algebra

### Rewrite literal equations (2.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Solve and rewrite literal equations</b> (A.REI.3, A.CED.4*)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Solve multi-step literal equations involving more than 2 variables <u>in contextual situations</u>	Solve multi-step literal equations involving <u>more than 2 variables</u>	Solve multi-step literal equations involving <u>2 variables</u>	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

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

## Foundations of Algebra

### Solve absolute value equations and inequalities (2.3)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Solve absolute value equations and inequalities</b> (A.REI.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following:	Solve absolute value equations and inequalities ( <b><u>including graph of inequality as part of solution</u></b> )	Solve absolute value equations <b><u>and</u></b> inequalities	Solve absolute value equations <b><u>or</u></b> inequalities	Little evidence of reasoning or application to solve the problem
<b>Represent constraints and interpret solutions</b> (A.CED.3*)	<ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Write the constraints for a contextual situation  <b><u>Interpret solutions as viable or nonviable options</u></b> in context of the situation.	<b><u>Write</u></b> the constraints for a contextual situation  Identify solutions <b><u>in context of the situation.</u></b>	Identify the constraints for a contextual situation  Identify solutions	Does not meet the criteria in a level 1

A.REI.3 Solve linear equations and inequalities in one variable, ~~including equations with coefficients represented by letters.~~

A.CED.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.

## Functions

### Understand and interpret functions (3.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Understand functions</b> (F.IF.1)	<p>Can extend thinking beyond the standard, including tasks that may involve one of the following:</p> <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> </ul>	<p>Determine and explain if a relation, graph <u>and</u> table are functions</p> <p>Use the different terminology that describes the x values (domain, input) and the y values (output, <math>f(x)</math>) to find the domain and range from a table, relation, <u>and</u> graph.</p>	<p>Determine <u>and explain</u> if a relation, graph or table are functions <b>(2 of the 3)</b></p> <p><u>Use</u> the different terminology that describes the x values (domain, input) and the y values (output, <math>f(x)</math>) to find the domain and range <b>from a table, relation, or graph.</b></p>	<p>Determine if a relation, graph <u>or</u> table are functions <b>(2 of the 3)</b></p> <p>Identify the different terminology that describes the x values (domain, input) and the y values (output, <math>f(x)</math>)</p>	<p>Little evidence of reasoning or application to solve the problem</p> <p>Does not meet the criteria in a level 1</p>
<b>Use function notation</b> (F.IF.2)	<ul style="list-style-type: none"> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	<p>Use function notation and the values in the domain to calculate the values in the range from a table, graph, and equation <u>and interpret statements using function notation in context of a given situation</u></p>	<p>Use function notation and the values in the domain to calculate the values in the range from a table, graph, <u>and</u> equation</p>	<p>Use function notation and the values in the domain to calculate the values in the range from a table, graph, <u>or</u> equation</p>	

F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .

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

## Functions

### Analyze sequences and functions (3.2/3.3)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Construct linear and exponential functions</b> (F.BF.1a, F.BF.2*, F.IF.3, F.LE.1, F.LE.2)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Distinguish between linear and exponential functions from arithmetic and geometric sequences, tables, graphs, and <u>real world situations</u>  Write the recursive function and the function rule for linear and exponential functions <u>to model real world situations.</u>	Distinguish between linear and exponential functions from arithmetic and geometric sequences, tables, and graphs.  <u>Write the recursive function and the function rule</u> for linear and exponential functions from arithmetic and geometric sequences and tables.	<u>Distinguish</u> between linear and exponential functions from arithmetic and geometric sequences, tables, and graphs.  <u>Identify the common difference/common ratio</u> for linear and exponential functions from arithmetic and geometric sequences and from tables.	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1
<b>Calculate and interpret rate of change</b> (F.IF.6*, F.LE.3)		Calculate the average rate of change over a given interval and explain the meaning in context for linear and exponential functions presented symbolically, in a table, <u>and</u> in a graph  <u>Describe that an increasing exponential function will eventually exceed a linear function</u>	Calculate the average rate of change over a given interval <u>and explain the meaning in context</u> for linear and exponential functions presented symbolically, in a table, or in a graph	Calculate the average rate of change over a given interval for linear and exponential functions presented symbolically, in a table, or in a graph	

- F.BF.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.~~
- F.BF.2\* Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. \*(Modeling Standard)
- F.IF.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  $n \geq 1$ .
- F.LE.2\* Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). \*(Modeling Standard)
- F.LE.1\* Distinguish between situations that can be modeled with linear functions and with exponential functions. \*(Modeling Standard)  
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
- F.IF.6\* Calculate and interpret the average rate of change of a linear, exponential, ~~or quadratic~~ function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph of a function over a specified interval. \*
- F.LE.3\* Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, ~~quadratically, or (more generally) as a polynomial function.~~ \*(Modeling Standard)

## Functions

### Analyze and compare graphs of linear and exponential functions (4.1/4.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Identify and compare key features</b> (F.IF.4, F.LE.5, F.IF.5, F.IF.9*, F.LE.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Identify and compare key features of two functions represented in <b>all</b> of the following ways <ul style="list-style-type: none"> <li>• algebraically</li> <li>• graphically</li> <li>• tables</li> <li>• in context</li> </ul>	Identify and compare key features of two functions represented in <b>three</b> of the following ways <ul style="list-style-type: none"> <li>• algebraically</li> <li>• graphically</li> <li>• tables</li> <li>• in context</li> </ul>	Identify and compare key features of two functions represented in <b>two</b> of the following ways <ul style="list-style-type: none"> <li>• algebraically</li> <li>• graphically</li> <li>• tables</li> <li>• in context</li> </ul>	
<b>Calculate and interpret rate of change</b> (F.IF.6*)		Calculate the average rate of change over a given interval and explain the meaning in context for linear and exponential functions presented as an equation, table, <b>and</b> graph	Calculate the average rate of change over a given interval <b>and explain the meaning in context</b> for linear and exponential functions presented as an equation, table, or graph	Calculate the average rate of change over a given interval for linear and exponential functions presented as an equation, table, <b>or</b> graph	
<b>Understand solutions</b> (A.REI.10)		<b>Explain</b> that all solutions to an equation in two variables are contained on the graph of that equation	Verifies that <b>multiple solutions</b> to an equation in two variables are contained on the graph of that equation.	<b>Verifies that one solution</b> to an equation in two variables is contained on the graph of that equation.	

- F.IF.4 For a linear, exponential, ~~or quadratic function~~ that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. \*
- F.LE.5\* Interpret the parameters in a linear or exponential function in terms of a context. \*(Modeling Standard)
- F.IF.5 Relate the domain of a linear, exponential, or quadratic 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. \*
- F.IF.9\* Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
- F.IF.6\* Calculate and interpret the average rate of change of a linear, exponential, ~~or quadratic~~ function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph of a function over a specified interval. \*
- A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.



## Systems of Equations & Inequalities

### Solve systems of equations (5.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<p><b>Create systems of equations</b> (A.CED.2*)</p> <p><b>Solve systems of equations</b> (A.CED.2, A.REI.6, A.CED.4*)</p>	<p>Can extend thinking beyond the standard, including tasks that may involve one of the following:</p> <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	<p>Create a system of equations to model a situation</p> <p>Solve a system of linear equations approximately (graphing <b>with labels and scales</b>) and exactly (algebraically) when multiplication or rearranging is necessary</p>	<p><b>Create</b> a system of equations to model a situation</p> <p>Solve a system of linear equations approximately (graphing) and exactly (algebraically) <b>when multiplication or rearranging is necessary</b></p>	<p><b>Identify</b> a system of equations to model a situation</p> <p>Solve a system of linear equations approximately (graphing) and exactly (algebraically)</p>	<p>Little evidence of reasoning or application to solve the problem</p> <p>Does not meet the criteria in a level 1</p>
<p><b>Explaining solutions</b> (A.REI.5, A.REI.11*)</p>		<p>Explain a solution to a system of equations (algebraically, graphically, or with tables) <b>in context of a given situation</b></p>	<p><b>Explain a solution</b> to a system of equations (algebraically, graphically, or with tables)</p>	<p><b>Verify</b> solutions to a system of equations (algebraically, graphically, or with tables)</p>	

A.REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. .

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

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

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

A.REI.11\* Explain why the x-coordinates of the points where the graphs of the equations  $y = f(x)$  and  $y = g(x)$  intersect are the solutions of the equation  $f(x) = g(x)$ ; find solutions to  $f(x) = g(x)$  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, quadratic, or exponential functions. \*(Modeling Standard)

## Systems of Equations & Inequalities

Solve and use systems of inequalities in decision making (5.1/5.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Graph inequalities and systems of Inequalities</b> (A.REI.12, A.CED.4)	Can extend thinking beyond the standard, including tasks that may involve one of the following:	Graph a system of linear inequalities in two variables from contextual situations ( <b>standard form</b> ) and identify the solution set.	Graph <b>a system of linear</b> inequalities in two variables from contextual situations (slope intercept form) and identify the solution set.	Graph <b>a linear inequality</b> in two variables from contextual situations (slope intercept form) and identify the solution set.	Little evidence of reasoning or application to solve the problem
<b>Represent constraints and interpret solutions</b> (A.CED.3*)	<ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Write the constraints for a contextual situation  <b>Interpret solutions as viable or nonviable options</b> in context of the situation.	<b>Write</b> the constraints for a contextual situation  Interpret solutions <b>in context of the situation.</b>	Identify the constraints for a contextual situation  Identify solutions	Does not meet the criteria in a level 1

A.REI.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

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

A.CED.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.

## Exponents and Exponential Functions

### Investigate rational exponents (7.3)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Rewrite expressions with exponents</b> (N.RN.2)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Convert between rational exponents and radical expressions  Use the properties of exponents to rewrite (simplify) radical expressions	Convert between rational exponents and radical expressions  Use the properties of exponents to rewrite (simplify) radical expressions ( <b>limited to square roots and cube roots</b> )	Convert between rational exponents and radical expressions	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1
<b>Explain rational exponents</b> (N.RN.1)		<b>Explain</b> how a radical expression can be represented by rational exponents	Show how a radical expression can be represented by <b>rational</b> exponents	Show how an expression can be represented by <b>integer</b> exponents	
<b>Create equivalent expressions</b> (A.SSE.3c)		<b>Create</b> equivalent expressions using rational exponents and radical expressions	<b>Create</b> equivalent expressions using rational exponents and radical expressions ( <b>limited to square and cube roots</b> )	<b>Identify</b> equivalent expressions using rational exponents and radical expressions	

N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define  $5^{1/3}$  to be the cube root of 5 because we want  $(5^{1/3})^3 = 5^{((1/3)3)}$  to hold, so  $(5^{1/3})^3$  must equal 5.

N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

A.SSE.3c 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  $1.15t$  can be rewritten as  $(1.151/12)^{12t} \approx 1.01212t$  to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

## Exponents and Exponential Functions

### Represent exponential functions (8.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Identify transformations</b> (F.BF.3)	<p>Can extend thinking beyond the standard, including tasks that may involve one of the following:</p> <ul style="list-style-type: none"> <li>Designing</li> <li>Connecting</li> <li>Synthesizing</li> <li>Applying</li> <li>Justifying</li> <li>Critiquing</li> <li>Analyzing</li> <li>Creating</li> <li>Proving</li> </ul>	<p>Identify the effect on a graph by replacing <math>f(x)</math> with a single transformation:</p> <ul style="list-style-type: none"> <li><math>f(x) + k</math></li> <li><math>k f(x)</math>,</li> <li><math>f(kx)</math></li> <li><math>f(x + k)</math></li> </ul> <p>for specific positive and negative values of <math>k</math></p> <p>Given the graph of a function and a single transformation (<b>for all listed above</b>), find the value of the constant or coefficient</p>	<p>Identify the effect on a graph by replacing <math>f(x)</math> with a single transformation (<b>3 of the 4</b>):</p> <ul style="list-style-type: none"> <li><math>f(x) + k</math></li> <li><math>k f(x)</math>,</li> <li><math>f(kx)</math></li> <li><math>f(x + k)</math></li> </ul> <p>for specific positive and negative values of <math>k</math></p> <p>Given the graph of a function and a single transformation (<b>3 of the 4 listed above</b>), find the value of the constant or coefficient</p>	<p>Identify the effect on a graph by replacing <math>f(x)</math> with a single transformation (<b>2 of the 4</b>):</p> <ul style="list-style-type: none"> <li><math>f(x) + k</math></li> <li><math>k f(x)</math>,</li> <li><math>f(kx)</math></li> <li><math>f(x + k)</math></li> </ul> <p>for specific positive and negative values of <math>k</math></p> <p>Given the graph of a function and a single transformation (<b>2 of the 4 listed above</b>), find the value of the constant or coefficient</p>	<p>Little evidence of reasoning or application to solve the problem</p> <p>Does not meet the criteria in a level 1</p>
<b>Interpret key features</b> (F.IF.4*, F.IF.5)		<p>Identify and interpret <u>all</u> key features in a table <u>and</u> graph in context of the situation.</p> <ul style="list-style-type: none"> <li>intercepts</li> <li>intervals where functions are increasing or decreasing</li> <li>intervals where the function is positive or negative</li> <li>end behavior</li> <li>domain</li> </ul> <p>Translate a verbal description of a relationship to sketch a linear, <u>and</u> exponential graph.</p>	<p>Identify <u>all</u> and interpret <u>at least 3</u> key features from a table <u>or</u> graph in <u>context of the situation</u>.</p> <ul style="list-style-type: none"> <li>intercepts</li> <li>intervals where functions are increasing or decreasing</li> <li>intervals where the function is positive or negative</li> <li>end behavior</li> <li>domain</li> </ul> <p>Translate a verbal description of a graph's key features to <u>sketch</u> a linear <u>or</u> exponential graph.</p>	<p>Identify <u>at least 3</u> key features from a table <u>or</u> graph</p> <ul style="list-style-type: none"> <li>intercepts</li> <li>intervals where functions are increasing or decreasing</li> <li>intervals where the function is positive or negative</li> <li>end behavior</li> <li>domain</li> </ul> <p>Translate a verbal description of a graph's key features to <u>identify</u> a linear <u>or</u> exponential graph.</p>	
<b>Calculate and interpret rate of change</b> (F.IF.6*)		<p>Calculate the average rate of change over a given interval and explain the meaning in context for linear and exponential functions presented in symbolic, table <u>and</u> graph form</p>	<p>Calculate the average rate of change over a given interval <u>and explain the meaning in context</u> for linear and exponential functions presented in symbolic, table <u>or</u> graph form</p>	<p>Calculate the average rate of change over a given interval for linear and exponential functions presented in symbolic, table <u>or</u> graph form</p>	
<b>Combine functions</b> (F.BF.1)		<p>Combine linear, exponential, and quadratic functions <u>to model real world situations</u>.</p>	<p>Combine linear, exponential, <u>and</u> quadratic functions</p>	<p>Combine linear, exponential, <u>or</u> quadratic functions</p>	

- F.BF.1 Write a function that describes a relationship between two quantities.
- Determine an explicit expression, a recursive process or steps for calculation from a context.
  - Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to decaying exponential and relate these functions to the model
- F.BF.3 Identify the effect on the graph of replacing  $f(x)$  by  $f(x + k)$ ,  $k f(x)$ ,  $f(kx)$  and  $f(x) + k$ , for specific values of  $k$  (both negative and positive); 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.
- F.IF.4 For a linear, exponential, or quadratic function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. \*
- F.IF.5 Relate the domain of a linear, exponential, ~~or quadratic 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. \*
- F.IF.6\* Calculate and interpret the average rate of change of a linear, exponential, ~~or quadratic~~ function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph of a function over a specified interval. \*

## Exponents and Exponential Functions

### Analyze growth and decay models (8.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Interpret key features of exponential growth and decay</b> (F.LE.5*, A.SSE.1b*, F.IF.8b)	Can extend thinking beyond the standard, including tasks that may involve one of the following:	Differentiate between exponential growth and exponential decay  Interpret the growth rate <b>and the growth factor</b> of exponential functions in context of the situation	Differentiate between exponential growth and exponential decay  <b>Interpret</b> the growth rate of exponential functions <b>in context of the situation</b>	Differentiate between exponential growth and exponential decay  Identify the growth rate of exponential functions	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1
<b>Create and graph equations</b> (A.CED.2*, F.IF.7e)	<ul style="list-style-type: none"> <li>Designing</li> <li>Connecting</li> <li>Synthesizing</li> <li>Applying</li> <li>Justifying</li> <li>Critiquing</li> <li>Analyzing</li> <li>Creating</li> <li>Proving</li> </ul>	Create equations in two or more variables to represent relationships in contextual situations  Graph exponential functions expressed in symbolic form and show key features of the graph ( <b>including labels and scales on the graph</b> )	<b>Create</b> equations in two or more variables to represent relationships in contextual situations  Graph exponential functions expressed in symbolic form <b>and show key features of the graph</b>	<b>Identify</b> equations in two or more variables to represent relationships in contextual situations  Graph exponential functions expressed in symbolic form	
<b>Rewrite and explain expressions</b> (A.SSE.3c)		Use properties of exponents, including rational exponents, to write an equivalent exponential <b>function to reveal and explain specific information</b>	Use properties of exponents, <b>including rational exponents</b> , to write an equivalent exponential function	Use properties of exponents, including rational exponents ( <b>only <math>\frac{1}{2}</math></b> ), to write an equivalent exponential function	
<b>Distinguish between linear and exponential</b> (F.LE.1*)		Explain whether a function is linear or exponential by describing its growth over intervals of equal width when analyzing a table, a graph, <b>and</b> function rule in context of a situation	<b>Explain whether a function is linear or exponential by describing its growth over intervals of equal width</b> when analyzing a table, a graph, <b>or</b> function rule in context of a situation	<b>Recognize</b> a linear or exponential function when analyzing a table, a graph, <b>or</b> function rule, in context of a situation	
<b>Find solutions graphically</b> (A.REI.11)		For linear and/or exponential functions, find intersection points using technology, graphs, and tables and <b>explain in the context of a situation</b>	For linear and/or exponential functions, find intersection points using technology, graphs, <b>and</b> tables	For linear and/or exponential functions, find intersection points using technology, graphs <b>or</b> tables	

A.SSE.1b\* Interpret expressions that represent a quantity in terms of its context.

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

A.SSE.3c 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  $1.15t$  can be rewritten as  $(1.151/12)^{12t} \approx 1.01212t$  to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

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

A.REI.11\* Explain why the x-coordinates of the points where the graphs of the equations  $y = f(x)$  and  $y = g(x)$  intersect are the solutions of the equation  $f(x) = g(x)$ ; find solutions to  $f(x) = g(x)$  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, quadratic, or exponential functions. \*(Modeling Standard)

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

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

b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as  $y = (1.02)^t$ ,  $y = (0.97)^t$ ,  $y = (1.01)^{12t}$ ,  $y = (1.2)^t/10$ , and classify them as representing exponential growth or decay.

F.LE.1\* Distinguish between situations that can be modeled with linear functions and with exponential functions. \*(Modeling Standard)

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.

F.LE.5\* Interpret the parameters in a linear or exponential function in terms of a context. \*(Modeling Standard)

## Polynomials

### Perform operations on polynomials (9.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Add, subtract, and multiply polynomials</b> (A.APR.1)	Can extend thinking beyond the standard, including tasks that may involve one of the following:	Add, subtract, and multiply polynomials <b><u>all within the same problem</u></b>	Add, subtract, <b><u>and multiply</u></b> polynomials	<b><u>Add and subtract</u></b> polynomials	Little evidence of reasoning or application to solve the problem
<b>Interpret expressions</b> (A.SSE.1*)	<ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Identify individual parts or groups of parts in an expression (such as terms, factors, etc.) <b><u>and explain their meaning in terms of a given context</u></b>	Identify individual parts <b><u>or groups of parts</u></b> in an expression (such as terms, factors, etc.)	<b><u>Identify</u></b> individual parts of an expression (such as terms, variables, etc.)	Does not meet the criteria in a level 1

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

A.SSE.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.

## Polynomials

### Factor polynomials (9.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Factor polynomials</b> (A.SSE.2)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> </ul>	Rewrite expressions in different equivalent forms by <ul style="list-style-type: none"> <li>• factoring using greatest common factors</li> <li>• factor using a difference of two squares</li> <li>• factor a trinomial</li> <li>• factor a trinomial with more than 2 factors</li> </ul>	Rewrite expressions in different equivalent forms by <b>(3 out of 4)</b> <ul style="list-style-type: none"> <li>• factoring using greatest common factors</li> <li>• factor using a difference of two squares</li> <li>• factor a trinomial</li> <li>• factor a trinomial with more than 2 factors</li> </ul>	Rewrite expressions in different equivalent forms by <b>(2 out of 4)</b> <ul style="list-style-type: none"> <li>• factoring using greatest common factors</li> <li>• factor using a difference of two squares</li> <li>• factor a trinomial</li> <li>• factor a trinomial with more than 2 factors</li> </ul>	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1
<b>Interpret expressions</b> (A.SSE.1*)	<ul style="list-style-type: none"> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Identify individual parts or groups of parts in an expression (such as terms, factors, etc.) <b>and explain their meaning in terms of a given context</b>	Identify individual parts <b>or groups of parts</b> in an expression (such as terms, factors, etc.)	<b>Identify</b> individual parts of an expression (such as terms, variables, etc.)	

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

A.SSE.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.



## Quadratic Functions

### Solve quadratic equations (10.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Solve quadratic equations</b> (A.REI.4)	<p>Can extend thinking beyond the standard, including tasks that may involve one of the following:</p> <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> </ul>	<p>Solve quadratic equations using <b>all</b> of the following methods</p> <ul style="list-style-type: none"> <li>• inspection</li> <li>• taking square roots,</li> <li>• completing the square,</li> <li>• the quadratic formula</li> <li>• factoring</li> </ul>	<p>Solve quadratic equations by <b>using three</b> of the following methods:</p> <ul style="list-style-type: none"> <li>• inspection</li> <li>• taking square roots</li> <li>• completing the square</li> <li>• the quadratic formula</li> <li>• factoring</li> </ul>	<p>Solve quadratic equations by <b>using two</b> of the following methods:</p> <ul style="list-style-type: none"> <li>• inspection</li> <li>• taking square roots</li> <li>• completing the square</li> <li>• the quadratic formula</li> <li>• factoring</li> </ul>	<p>Little evidence of reasoning or application to solve the problem</p> <p>Does not meet the criteria in a level 1</p>
<b>Explain rational and irrational operations</b> (N.RN.3)	<ul style="list-style-type: none"> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	<p>Justify <b>all of</b> the following:</p> <ul style="list-style-type: none"> <li>• when adding or multiplying two rational numbers the result is a rational number.</li> <li>• when adding a rational number and an irrational number the result is irrational.</li> <li>• multiplying a nonzero rational number and an irrational number the result is irrational.</li> </ul>	<p>Justify <b>two</b> of the following:</p> <ul style="list-style-type: none"> <li>• when adding or multiplying two rational numbers the result is a rational number.</li> <li>• when adding a rational number and an irrational number the result is irrational.</li> <li>• multiplying a nonzero rational number and an irrational number the result is irrational.</li> </ul>	<p>justify <b>one</b> of the following:</p> <ul style="list-style-type: none"> <li>• when adding or multiplying two rational numbers the result is a rational number.</li> <li>• when adding a rational number and an irrational number the result is irrational.</li> <li>• multiplying a nonzero rational number and an irrational number the result is irrational.</li> </ul>	

A.REI.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  $b$ .

N.RN.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.

## Quadratic Functions

### Analyze quadratic functions (10.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Identify key features of quadratic functions</b> (F.IF.8, A.SSE.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Use factoring and completing the square in a quadratic function to determine <b>all</b> of the following <ul style="list-style-type: none"> <li>• the vertex</li> <li>• axis of symmetry,</li> <li>• direction of opening,</li> <li>• zeros/roots</li> </ul> in context of the situation	<u>Use factoring and completing the square</u> in a quadratic function to determine <b>2 of the following</b> <ul style="list-style-type: none"> <li>• the vertex</li> <li>• axis of symmetry,</li> <li>• direction of opening,</li> <li>• zeros/roots</li> </ul> <u>in context of the situation</u>	<u>Given a quadratic function</u> in <ul style="list-style-type: none"> <li>• vertex form find the vertex;</li> <li>• factored form find the zeros/roots;</li> <li>• standard form find the direction of opening</li> </ul>	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1

F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.  
 a. Use the process of factoring and completing the square in a quadratic functions to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

A.SSE.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.

## Graphs of Non-Linear Functions

### Analyze graphs of quadratic functions (11.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Graph and identify key features of quadratic functions</b> (F.IF.7a, F.IF.8a)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Use factoring and completing the square in a quadratic function to determine <ul style="list-style-type: none"> <li>• the vertex</li> <li>• axis of symmetry,</li> <li>• direction of opening,</li> <li>• zeros/roots</li> </ul> <b><u>in context of the situation</u></b>  Graph quadratic functions expressed in vertex form and standard form and show key features of the graph <b><u>in context of a situation.</u></b>	<b><u>Use factoring and completing the square</u></b> in a quadratic function to determine <ul style="list-style-type: none"> <li>• the vertex</li> <li>• axis of symmetry,</li> <li>• direction of opening,</li> <li>• zeros/roots</li> </ul> Graph quadratic functions expressed in vertex form <b><u>and</u></b> standard form, and show key features of the graph	<b><u>Given a quadratic function</u></b> in <ul style="list-style-type: none"> <li>• vertex form find the vertex;</li> <li>• factored form find the zeros/roots;</li> <li>• standard form find the direction of opening</li> </ul> Graph quadratic functions expressed in vertex form <b><u>or</u></b> standard form, and show key features of the graph	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1
<b>Interpret key features</b> (F.IF.4*, F.IF.5)		Identify and interpret <b><u>all</u></b> key features in a table <b><u>and</u></b> graph in terms of the quantities. <ul style="list-style-type: none"> <li>• intercepts</li> <li>• intervals where functions are increasing or decreasing</li> <li>• intervals where the function is positive or negative</li> <li>• local minimums and maximums</li> <li>• whether or not a graph has symmetries</li> <li>• end behavior</li> <li>• domain</li> </ul> Translate a verbal description of a <b><u>relationship</u></b> to sketch a quadratic graph.	<b><u>Identify all</u></b> key features <b><u>and interpret at least 4</u></b> key features from a table <b><u>or</u></b> graph in terms of the quantities. <ul style="list-style-type: none"> <li>• intercepts</li> <li>• intervals where functions are increasing or decreasing</li> <li>• intervals where the function is positive or negative</li> <li>• local minimums and maximums</li> <li>• whether or not a graph has symmetries</li> <li>• end behavior</li> <li>• domain</li> </ul> Translate a verbal description of a graph's key features to <b><u>sketch</u></b> a quadratic graph.	<b><u>Identify at least 6</u></b> key features from a table <b><u>or</u></b> graph <ul style="list-style-type: none"> <li>• intercepts</li> <li>• intervals where functions are increasing or decreasing</li> <li>• intervals where the function is positive or negative</li> <li>• local minimums and maximums</li> <li>• whether or not a graph has symmetries</li> <li>• end behavior</li> <li>• domain</li> </ul> Translate a verbal description of a graph's key features to <b><u>identify</u></b> a quadratic graph.	
<b>Compare key features</b> (F.IF.9*)		Compare key features of two functions represented <ul style="list-style-type: none"> <li>• algebraically</li> <li>• graphically</li> <li>• numerically in tables</li> <li>• verbal descriptions</li> </ul> Key features include: <ul style="list-style-type: none"> <li>• intercepts</li> <li>• minimums and maximums</li> <li>• rate of change</li> <li>• increasing or decreasing</li> <li>• <b><u>positive or negative</u></b></li> <li>• <b><u>symmetries</u></b></li> <li>• <b><u>end behavior</u></b></li> </ul>	Compare key features of two functions represented <ul style="list-style-type: none"> <li>• algebraically</li> <li>• graphically</li> <li>• numerically in tables</li> <li>• verbal descriptions</li> </ul> Key features include: <ul style="list-style-type: none"> <li>• intercepts</li> <li>• minimum and maximums</li> <li>• <b><u>rate of change</u></b></li> <li>• <b><u>increasing and decreasing</u></b></li> </ul>	Compare key features of two functions represented <ul style="list-style-type: none"> <li>• algebraically</li> <li>• graphically</li> <li>• numerically in tables</li> <li>• verbal descriptions</li> </ul> Key features include: <ul style="list-style-type: none"> <li>• intercepts</li> <li>• minimum and maximums</li> </ul>	

## Graphs of Non-Linear Functions

### Analyze graphs of quadratic functions (11.1 ) (Continued)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Identify transformations</b> (F.BF.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>Designing</li> <li>Connecting</li> <li>Synthesizing</li> <li>Applying</li> <li>Justifying</li> <li>Critiquing</li> <li>Analyzing</li> <li>Creating</li> <li>Proving</li> </ul>	Identify the effect on a graph by replacing $f(x)$ with a single transformation: <ul style="list-style-type: none"> <li><math>f(x) + k</math></li> <li><math>k f(x)</math>,</li> <li><math>f(kx)</math></li> <li><math>f(x + k)</math></li> </ul> for specific positive and negative values of $k$  Given the graph of a function and a single transformation ( <b>for all listed above</b> ), find the value of the constant or coefficient	Identify the effect on a graph by replacing $f(x)$ with a single transformation ( <b>3 of the 4</b> ): <ul style="list-style-type: none"> <li><math>f(x) + k</math></li> <li><math>k f(x)</math>,</li> <li><math>f(kx)</math></li> <li><math>f(x + k)</math></li> </ul> for specific positive and negative values of $k$  Given the graph of a function and a single transformation ( <b>3 of the 4 listed above</b> ), find the value of the constant or coefficient	Identify the effect on a graph by replacing $f(x)$ with a single transformation ( <b>2 of the 4</b> ): <ul style="list-style-type: none"> <li><math>f(x) + k</math></li> <li><math>k f(x)</math>,</li> <li><math>f(kx)</math></li> <li><math>f(x + k)</math></li> </ul> for specific positive and negative values of $k$  Given the graph of a function and a single transformation ( <b>2 of the 4 listed above</b> ), find the value of the constant or coefficient	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1
<b>Create quadratic equations</b> (A.CED.1*)		Create quadratic equations in vertex <b>and</b> standard form and use them in a contextual situation and solve problems.	<b>Create</b> quadratic equations in vertex or standard form and use them in a contextual situation and solve problems.	<b>Identify</b> quadratic equations in vertex <b>or</b> standard form to represent a contextual situation and use them to solve problems.	
<b>Combine functions</b> (F.BF.1)		Combine linear, exponential, and quadratic functions <b>to model real world situations.</b>	Combine linear, exponential, <b>and</b> quadratic functions	Combine linear, exponential, <b>or</b> quadratic functions	

- F.IF.4 For a ~~linear, exponential, or~~ quadratic function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. \*
- F.IF.5 Relate the domain of a ~~linear, exponential, or~~ quadratic 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. \*
- F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
- F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.  
a. Use the process of factoring and completing the square in a quadratic functions to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
- F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★  
a. Graph ~~linear and~~ quadratic functions and show intercepts, maxima, and minima.
- A.CED.1\* Create equations and inequalities in one variable and use them to solve problems
- F.BF.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.  
b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to decaying exponential and relate these functions to the model
- F.BF.3 Identify the effect on the graph of replacing  $f(x)$  by  $f(x + k)$ ,  $k f(x)$ ,  $f(kx)$  and  $f(x) + k$ , for specific values of  $k$  (both negative and positive); 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

## Graphs of Non-Linear Functions

Create and analyze non-linear functions (7.1/7.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Graph functions and identify key features</b> (F.IF.7b)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> </ul>	Graph all of the following functions: <ul style="list-style-type: none"> <li>• piecewise</li> <li>• step</li> <li>• absolute value</li> <li>• square root</li> <li>• cube root</li> </ul> <b>and identify key features</b>	Graph <b>all</b> of the following functions: <ul style="list-style-type: none"> <li>• piecewise</li> <li>• step</li> <li>• absolute value</li> <li>• square root</li> <li>• cube root</li> </ul>	Graph <b>at least 3</b> of the following functions: <ul style="list-style-type: none"> <li>• piecewise</li> <li>• step</li> <li>• absolute value</li> <li>• square root</li> <li>• cube root</li> </ul>	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1
<b>Create and graph equations</b> (A.CED.2*)	<ul style="list-style-type: none"> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Create equations in two or more variables to represent relationships in contextual situations, and graph the equation <b>with labels and scales</b>	<b>Create</b> equations in two or more variables to represent relationships in contextual situations, and graph the equation	<b>Identify</b> equations in two or more variables to represent relationships in contextual situations, and graph the equation	

F.IF.7b 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.

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

## Graphs of Non-Linear Functions

### Transformations of non-linear functions (7.1/7.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Identify transformations</b> (F.BF.3)	<p>Can extend thinking beyond the standard, including tasks that may involve one of the following:</p> <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	<p>Identify the effect on a graph by replacing <math>f(x)</math> with a single transformation:</p> <ul style="list-style-type: none"> <li>• <math>f(x) + k</math></li> <li>• <math>k f(x)</math>,</li> <li>• <math>f(kx)</math></li> <li>• <math>f(x + k)</math></li> </ul> <p>for specific positive and negative values of <math>k</math></p> <p>Given the graph of a function and a single transformation (<b>for all listed above</b>), find the value of the constant or coefficient</p>	<p>Identify the effect on a graph by replacing <math>f(x)</math> with a single transformation (<b>3 of the 4</b>):</p> <ul style="list-style-type: none"> <li>• <math>f(x) + k</math></li> <li>• <math>k f(x)</math>,</li> <li>• <math>f(kx)</math></li> <li>• <math>f(x + k)</math></li> </ul> <p>for specific positive and negative values of <math>k</math></p> <p>Given the graph of a function and a single transformation (<b>3 of the 4 listed above</b>), find the value of the constant or coefficient</p>	<p>Identify the effect on a graph by replacing <math>f(x)</math> with a single transformation (<b>2 of the 4</b>):</p> <ul style="list-style-type: none"> <li>• <math>f(x) + k</math></li> <li>• <math>k f(x)</math>,</li> <li>• <math>f(kx)</math></li> <li>• <math>f(x + k)</math></li> </ul> <p>for specific positive and negative values of <math>k</math></p> <p>Given the graph of a function and a single transformation (<b>2 of the 4 listed above</b>), find the value of the constant or coefficient</p>	<p>Little evidence of reasoning or application to solve the problem</p> <p>Does not meet the criteria in a level 1</p>

F.IF.7b 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.

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

## Descriptive Statistics

### Represent and analyze data (6.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Represent data</b> (S.ID.1*)	Can extend thinking beyond the standard, including tasks that may involve one of the following:	Represent data with plots on the real number line using <b>all of</b> the following models: <ul style="list-style-type: none"> <li>• Dot plot</li> <li>• Histograms</li> <li>• Box plots</li> </ul>	Represent data with plots on the real number line using <b>two</b> of the following models: <ul style="list-style-type: none"> <li>• Dot plot</li> <li>• Histograms</li> <li>• Box plots</li> </ul>	Represent data with plots on the real number line using <b>one</b> of the following models: <ul style="list-style-type: none"> <li>• Dot plot</li> <li>• Histograms</li> <li>• Box plots</li> </ul>	Little evidence of reasoning or application to solve the problem
<b>Compare center and spread</b> (S.ID.2*)	<ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Use statistics appropriate to the data to <b>compare</b> center (median, mean) and spread (interquartile range, standard deviation) of two or more data sets.	Calculates the center (median, mean) <b>and</b> spread (interquartile range, standard deviation) of two or more data sets.	Calculates center (median, mode) <b>or</b> spread (interquartile range, standard deviation) of two or more data sets.	Does not meet the criteria in a level 1
<b>Interpret data</b> (S.ID.3*)		Interpret differences in shape, center and spread <b>in the context</b> of the data sets accounting for possible effects of extreme data points (outliers)	Interpret differences in shape, center and spread <b>accounting for possible effects of extreme data points (outliers)</b>	Interpret differences in shape, center and spread.	

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

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

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

## Descriptive Statistics

### Analyze scatter plots (6.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Create and analyze scatter plots</b> (S.ID.6, S.ID.7, S.ID.8, S.ID.9)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	Represent data on two quantitative variables on a scatter plot, fit a function to the data <b><u>and use the function to solve problems in context of the data</u></b>  <b><u>Interpret</u></b> the slope and intercept of a linear model <b><u>in context of the data</u></b>  Compute <b><u>and interpret</u></b> the correlation coefficient of a linear fit <b><u>in context of the data</u></b>  <b><u>Determine whether correlation implies causation in data</u></b>	Represent data on a scatter plot <b><u>and fit a function to the data</u></b> (function may be linear, quadratic or exponential)  <b><u>Identify the slope and intercept</u></b> of a linear model  <b><u>Compute the correlation coefficient</u></b> of a linear fit.  <b><u>Determine if there is correlation in data</u></b>	Represent data on a scatter plot by hand <b><u>and</u></b> by technology	Little evidence of reasoning or application to solve the problem  Does not meet the criteria in a level 1

- S.ID.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; 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, quadratic, and exponential models.
  - b. Informally assess the fit of a function by plotting and analyzing residuals.
  - c. Fit a linear function for a scatter plot that suggests a linear association.
- S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.
- S.ID.9 Distinguish between correlation and causation.



## Descriptive Statistics

### Interpret two-way frequency tables (6.3)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
<b>Interpreting and analyzing frequency</b> (S.ID.5*)	<p>Can extend thinking beyond the standard, including tasks that may involve one of the following:</p> <ul style="list-style-type: none"> <li>• Designing</li> <li>• Connecting</li> <li>• Synthesizing</li> <li>• Applying</li> <li>• Justifying</li> <li>• Critiquing</li> <li>• Analyzing</li> <li>• Creating</li> <li>• Proving</li> </ul>	<p>Can do <b>all of</b> the following:</p> <p>Summarize categorical data for two categories in two-way frequency tables</p> <p>Interpret relative frequencies in the context (joint, marginal, and conditional relative frequencies)</p> <p>Recognize possible associations and trends</p>	<p>Can do <b>two</b> of the following:</p> <p>Summarize categorical data for two categories in two-way frequency tables</p> <p>Interpret relative frequencies in the context (joint, marginal, and conditional relative frequencies)</p> <p>Recognize possible associations and trends</p>	<p>Can do <b>one</b> of the following:</p> <p>Summarize categorical data for two categories in two-way frequency tables</p> <p>Interpret relative frequencies in the context (joint, marginal, and conditional relative frequencies)</p> <p>Recognize possible associations and trends</p>	<p>Little evidence of reasoning or application to solve the problem</p> <p>Does not meet the criteria in a level 1</p>

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