

Missouri Mathematics

# **Algebra 1 - Expanded**

## Seeing Structure in Expressions **SSE**

### **A Interpret and use structure** **SSE.A**

- 1** Interpret the contextual meaning of individual terms or factors from a given problem that utilizes formulas or expressions. **SSE.A.1**
  - a** interpret the contextual meaning of individual terms from a given problem that utilizes formulas **SSE.A.1.A**
  - b** interpret the contextual meaning of individual factors from a given problem that utilizes formulas **SSE.A.1.B**
  - c** interpret the contextual meaning of individual terms from a given problem that utilizes expressions **SSE.A.1.C**
  - d** interpret the contextual meaning of individual factors from a given problem that utilizes expressions **SSE.A.1.D**
  - e** interpret the meaning of individual terms based on the mathematics structures of a given problem that utilizes formulas **SSE.A.1.E**
  - f** interpret the meaning of individual factors based on the mathematics structures of a given problem that utilizes formulas **SSE.A.1.F**
  - g** interpret the meaning of individual terms based on the mathematics structures of a given problem that utilizes expressions **SSE.A.1.G**
  - h** interpret the meaning of individual factors based on the mathematics structures of a given problem that utilizes expressions **SSE.A.1.H**
- 2** Analyze the structure of polynomials to create equivalent expressions or equations. **SSE.A.2**
  - a** identify a polynomial **SSE.A.2.A**
  - b** analyze the structures of polynomials **SSE.A.2.B**
  - c** factor a polynomial expression **SSE.A.2.C**
  - d** factor a polynomial equation **SSE.A.2.D**
  - e** analyze the structure of polynomials to determine an appropriate method for decomposing and composing to create equivalent expressions **SSE.A.2.E**
  - f** analyze the structure of polynomials to determine an appropriate method for decomposing and composing to create equivalent equations **SSE.A.2.F**
- 3** Choose and produce equivalent forms of a quadratic expression or equations to reveal and explain properties. **SSE.A.3**
  - a** identify a quadratic expression **SSE.A.3.A**
  - b** identify a quadratic equation **SSE.A.3.B**
  - c** choose equivalent forms of a quadratic expression to reveal properties **SSE.A.3.C**
  - d** choose equivalent forms of a quadratic expression to explain properties **SSE.A.3.D**
  - e** choose equivalent forms of a quadratic equation to reveal properties **SSE.A.3.E**

- f** choose equivalent forms of a quadratic equation to explain properties **SSE.A.3.F**
  - g** produce equivalent forms of a quadratic expression to reveal properties **SSE.A.3.G**
  - h** produce equivalent forms of a quadratic expression to explain properties **SSE.A.3.H**
  - i** produce equivalent forms of a quadratic equation to reveal properties **SSE.A.3.I**
  - j** produce equivalent forms of a quadratic equation to explain properties **SSE.A.3.J**
  - k** factor a quadratic function **SSE.A.3.K**
  - l** find the zeros of a quadratic function by rewriting it in factored form **SSE.A.3.L**
  - m** find the maximum value of a quadratic function by completing the square **SSE.A.3.M**
  - n** find the minimum value of a quadratic function by completing the square **SSE.A.3.N**
  - o** understand that the vertex of an equation in the form  $y=a(x-h)^2 + k$  is  $(h,k)$ . **SSE.A.3.O**
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**A Create equations that describe linear, quadratic and exponential relationships.** CED.A

- 1 Create equations and inequalities in one variable and use them to model and/or solve problems. CED.A.1
  - a create linear equations in one variable CED.A.1.A
  - b create linear inequalities in one variable CED.A.1.B
  - c use linear equations in one variable to model problems CED.A.1.C
  - d use linear equations in one variable to solve problems CED.A.1.D
  - e use linear inequalities in one variable to model problems CED.A.1.E
  - f use linear inequalities in one variable to solve problems CED.A.1.F
  - g create quadratic equations in one variable CED.A.1.G
  - h use quadratic equations in one variable to model problems CED.A.1.H
  - i use quadratic equations in one variable to solve problems CED.A.1.I
  - j create exponential equations in one variable CED.A.1.J
  - k use exponential equations in one variable to model problems CED.A.1.K
  - l use exponential equations in one variable to solve problems CED.A.1.L
- 2 Create and graph linear, quadratic and exponential equations in two variables. CED.A.2
  - a create linear equations in two variables CED.A.2.A
  - b create quadratic equations in two variables CED.A.2.B
  - c create exponential equations in two variables CED.A.2.C
  - d graph linear equations in two variables with labels and scales CED.A.2.D
  - e graph quadratic equations in two variables with labels and scales CED.A.2.E
  - f graph exponential equations in two variables with labels and scales CED.A.2.F
- 3 Represent constraints by equations or inequalities and by systems of equations or inequalities, and interpret the data points as a solution or non-solution in a modeling context. CED.A.3
  - a identify a system of equations CED.A.3.A
  - b identify a system of inequalities CED.A.3.B
  - c identify a system of mixed equations and inequalities CED.A.3.C
  - d represent constraints by equations CED.A.3.D
  - e represent constraints by inequalities CED.A.3.E
  - f represent constraints by systems of equations CED.A.3.F
  - g represent constraints by systems of inequalities CED.A.3.G
  - h interpret data points as a solution to an equation in a modeling context CED.A.3.H

- i interpret data points as a solution to an inequality in a modeling context [CED.A.3.I](#)
  - j interpret data points as a solution to a system of equations in a modeling context [CED.A.3.J](#)
  - k interpret data points as a solution to a system of inequalities in a modeling context [CED.A.3.K](#)
  - l interpret data points as a non-solution to an equation in a modeling context [CED.A.3.L](#)
  - m interpret data points as a non-solution to an inequality in a modeling context [CED.A.3.M](#)
  - n interpret data points as a non-solution to a system of equations in a modeling context [CED.A.3.N](#)
  - o interpret data points as a non-solution to a system of inequalities in a modeling context [CED.A.3.O](#)
- 4 Solve literal equations and formulas for a specified variable that highlights a quantity of interest. [CED.A.4](#)
- a solve literal equations for a specified variable [CED.A.4.A](#)
  - b solve literal formulas for a specified variable [CED.A.4.B](#)
  - c in literal equations, determine which variable highlights a quantity of interest [CED.A.4.C](#)
  - d in literal formulas, determine which variable highlights a quantity of interest [CED.A.4.D](#)
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## Reasoning with Equations and Inequalities REI

### A Understand solving equations as a process, and solve equations and inequalities in one variable. REI.A

- 1 Explain how each step taken when solving an equation or inequality in one variable creates an equivalent equation or inequality that has the same solution(s) as the original. REI.A.1
  - a explain how each step taken when solving an equation in one variable creates an equivalent equation that has the same solution(s) as the original REI.A.1.A
  - b explain how each step taken when solving an inequality in one variable creates an equivalent inequality that has the same solution(s) as the original REI.A.1.B
- 2 Solve problems involving quadratic equations. REI.A.2
  - a identify a quadratic equation REI.A.2.A
  - b identify a quadratic expression REI.A.2.B
  - c use the method of completing the square to create an equivalent quadratic equation REI.A.2.C
  - d solve a standard quadratic equation for a certain value using the completing the square method REI.A.2.D
  - e derive the quadratic formula from the standard quadratic equation REI.A.2.E
  - f explain the relationship between the quadratic formula and the standard quadratic equation REI.A.2.F
  - g analyze the factoring method of solving quadratic equations REI.A.2.G
  - h solve quadratic equations using the factoring method REI.A.2.H
  - i analyze the completing the square method of solving quadratic equations REI.A.2.I
  - j solve quadratic equations using the completing the square method REI.A.2.J
  - k analyze the quadratic formula method of solving quadratic equations REI.A.2.K
  - l solve quadratic equations using the quadratic formula method REI.A.2.L
  - m analyze the graphing method of solving quadratic equations REI.A.2.M
  - n solve quadratic equations using the graphing method REI.A.2.N
  - o determine when a quadratic equation has no real solution REI.A.2.O
  - p determine the most efficient way to solve a given quadratic equation REI.A.2.P

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**B Solve systems of equations.** REI.B

- 3 Solve a system of linear equations algebraically and/or graphically. REI.B.3
  - a identify a system of linear equations REI.B.3.A
  - b solve a system of linear equations algebraically REI.B.3.B
  - c solve a system of linear equations graphically REI.B.3.C
- 4 Solve a system consisting of a linear equation and a quadratic equation algebraically and/or graphically. REI.B.4
  - a identify a system consisting of a linear equation and a quadratic equation REI.B.4.A
  - b solve a system consisting of a linear equation and a quadratic equation algebraically REI.B.4.B
  - c solve a system consisting of a linear equation and a quadratic equation graphically REI.B.4.C
- 5 Justify that the technique of linear combination produces an equivalent system of equations. REI.B.5
  - a justify that the technique of linear combination produces an equivalent system of equations REI.B.5.A
  - b identify when to use linear combination REI.B.5.B

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**C Represent and solve linear and exponential equations and inequalities graphically** REI.C

- 6 Explain that the graph of an equation in two variables is the set of all its solutions plotted in the Cartesian coordinate plane. REI.C.6
    - a explain that the graph of a linear equation in two variables is the set of all its solutions plotted in the Cartesian coordinate plane REI.C.6.A
    - b explain that the graph of an exponential equation in two variables is the set of all its solutions plotted in the Cartesian coordinate plane REI.C.6.B
    - c explain that any point not on the graph of a linear equation in the Cartesian coordinate plane is not a solution REI.C.6.C
    - d explain that any point not on the graph of an exponential equation in the Cartesian coordinate plane is not a solution REI.C.6.D
  - 7 Graph the solution to a linear inequality in two variables. REI.C.7
    - a find the solution to a linear inequality in two variables REI.C.7.A
    - b graph the solution to a linear inequality in two variables REI.C.7.B
  - 8 Solve problems involving a system of linear inequalities. REI.C.8
    - a identify a system of linear inequalities REI.C.8.A
    - b solve problems involving a system of linear inequalities REI.C.8.B
    - c given a context, interpret the solution to a system of linear inequalities REI.C.8.C
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**Arithmetic with  
Polynomials and  
Rational  
Expressions** APR

**A Perform operations on polynomials.** APR.A

- 1 Add, subtract and multiply polynomials, and understand that polynomials follow the same general rules of arithmetic and are closed under these operations. APR.A.1
    - a add polynomials APR.A.1.A
    - b subtract polynomials APR.A.1.B
    - c multiply polynomials APR.A.1.C
    - d given a context, determine whether to add, subtract, or multiply polynomials APR.A.1.D
    - e understand that polynomials follow the general rules of arithmetic APR.A.1.E
    - f understand that polynomials are closed under the operation of addition APR.A.1.F
    - g understand that polynomials are closed under the operation of subtraction APR.A.1.G
    - h understand that polynomials are closed under the operation of multiplication APR.A.1.H
  - 2 Divide polynomials by monomials. APR.A.2
    - a divide polynomials by monomials APR.A.2.A
    - b given a context, determine when to divide polynomials by monomials APR.A.2.B
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## Interpreting Functions IF

### A Understand the concept of a function and use function notation. IF.A

- 1 Understand that a function from one set (domain) to another set (range) assigns to each element of the domain exactly one element of the range. IF.A.1
  - a understand domain IF.A.1.A
  - b understand range IF.A.1.B
  - c understand that a function assigns to each element of the domain exactly one element of the range IF.A.1.C
  - d understand that  $f(x)$  denotes the elements of the range of a function  $f$  that correspond to the elements of the domain  $(x)$ . IF.A.1.D
  - e identify function notation IF.A.1.E
  - f represent a function using function notation IF.A.1.F
  - g understand that the input and output values of a function correspond to  $(x,y)$  values on the Cartesian coordinate plane IF.A.1.G
  - h understand that the graph of a function labeled  $f$  is the set of all ordered pairs  $(x, y)$  that satisfy the equation  $y=f(x)$  IF.A.1.H
  - i graph an equation presented using functional notation IF.A.1.I
- 2 Use function notation to evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. IF.A.2
  - a use function notation to evaluate functions for inputs in their domains IF.A.2.A
  - b interpret statements that use function notation in terms of a context IF.A.2.B
  - c interpret statements involving inputs of a function in terms of a context IF.A.2.C
  - d interpret statements involving outputs of a function in terms of context IF.A.2.D
  - e solve problems presented in function notation IF.A.2.E

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**B Interpret linear, quadratic and exponential functions in terms of the context.** IF.B

- 3 Using tables, graphs and verbal descriptions, interpret key characteristics of a function that models the relationship between two quantities. IF.B.3
  - a using tables, interpret key characteristics of a linear function that models the relationship between two quantities IF.B.3.A
  - b using graphs, interpret key characteristics of a linear function that models the relationship between two quantities IF.B.3.B
  - c using verbal descriptions, interpret key characteristics of a linear function that models the relationship between two quantities IF.B.3.C
  - d using tables, interpret key characteristics of a quadratic function that models the relationship between two quantities IF.B.3.D
  - e using graphs, interpret key characteristics of a quadratic function that models the relationship between two quantities IF.B.3.E
  - f using verbal descriptions, interpret key characteristics of a quadratic function that models the relationship between two quantities IF.B.3.F
  - g using tables, interpret key characteristics of an exponential function that models the relationship between two quantities IF.B.3.G
  - h using graphs, interpret key characteristics of an exponential function that models the relationship between two quantities IF.B.3.H
  - i using verbal descriptions, interpret key characteristics of an exponential function that models the relationship between two quantities IF.B.3.I
- 4 Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. IF.B.4
  - a relate the domain of a linear function to its graph IF.B.4.A
  - b relate the range of a linear function to its graph IF.B.4.B
  - c describe how, within the context of a situation, the domain and range of a linear function affect the characteristics of the graph of the function IF.B.4.C
  - d relate the domain of a quadratic function to its graph IF.B.4.D
  - e relate the range of a quadratic function to its graph IF.B.4.E
  - f describe how, within the context of a situation, the domain and range of a quadratic function affect the characteristics of the graph of the function IF.B.4.F
  - g relate the domain of an exponential function to its graph IF.B.4.G
  - h relate the range of an exponential function to its graph IF.B.4.H
  - i describe how, within the context of a situation, the domain and range of an exponential function affect the characteristics of the graph of the function IF.B.4.I
- 5 Determine the average rate of change of a function over a specified interval and interpret the meaning. IF.B.5

- a determine the average rate of change of a linear function over a specified interval **IF.B.5.A**
  - b interpret the meaning of the average rate of change of a linear function over a specified interval in a given context **IF.B.5.B**
  - c determine the average rate of change of a quadratic function over a specified interval **IF.B.5.C**
  - d interpret the meaning of the average rate of change of a quadratic function over a specified interval in a given context **IF.B.5.D**
  - e determine the average rate of change of an exponential function over a specified interval **IF.B.5.E**
  - f interpret the meaning of the average rate of change of an exponential function over a specified interval in a given context **IF.B.5.F**
- 6** Interpret the parameters of a linear or exponential function in terms of the context. **IF.B.6**
- a identify the parameters of a linear function **IF.B.6.A**
  - b identify the parameters of an exponential function **IF.B.6.B**
  - c interpret the parameters of a linear function in terms of the context **IF.B.6.C**
  - d interpret the parameters of an exponential function in terms of the context **IF.B.6.D**

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**C Analyze linear, quadratic and exponential functions using different representations.** IF.C

- 7 Graph functions expressed symbolically and identify and interpret key features of the graph. IF.C.7
- a by hand, graph linear equations expressed symbolically IF.C.7.A
  - b by hand, identify key features of the graph of a linear function IF.C.7.B
  - c by hand, interpret key features of the graph of a linear function IF.C.7.C
  - d by hand, graph quadratic equations expressed symbolically IF.C.7.D
  - e by hand, identify key features of the graph of a quadratic function IF.C.7.E
  - f by hand, interpret key features of the graph of a quadratic function IF.C.7.F
  - g by hand, graph exponential equations expressed symbolically IF.C.7.G
  - h by hand, identify key features of the graph of an exponential function IF.C.7.H
  - i by hand, interpret key features of the graph of an exponential function IF.C.7.I
  - j by hand, graph simple piecewise functions expressed symbolically IF.C.7.J
  - k by hand, identify key features of the graph of a simple piecewise function IF.C.7.K
  - l by hand, interpret key features of the graph of a simple piecewise function IF.C.7.L
  - m using technology, graph linear equations expressed symbolically IF.C.7.M
  - n using technology, identify key features of the graph of a linear function IF.C.7.N
  - o using technology, interpret key features of the graph of a linear function IF.C.7.O
  - p using technology, graph quadratic equations expressed symbolically IF.C.7.P
  - q using technology, identify key features of the graph of a quadratic function IF.C.7.Q
  - r using technology, interpret key features of the graph of a quadratic function IF.C.7.R
  - s using technology, graph exponential equations expressed symbolically IF.C.7.S
  - t using technology, identify key features of the graph of an exponential function IF.C.7.T
  - u using technology, interpret key features of the graph of an exponential function IF.C.7.U
  - v using technology, graph simple piecewise functions expressed symbolically IF.C.7.V
  - w using technology, identify key features of the graph of a simple piecewise function IF.C.7.W

- x using technology, interpret key features of the graph of a simple piecewise function IF.C.7.X
- 8 Translate between different but equivalent forms of a function to reveal and explain properties of the function and interpret these in terms of a context. IF.C.8
- a translate between different but equivalent forms of a linear function IF.C.8.A
  - b use equivalent forms of a linear function to reveal properties of the function IF.C.8.B
  - c use equivalent forms of a linear function to explain properties of the function IF.C.8.C
  - d interpret different but equivalent forms of a linear function in terms of a context IF.C.8.D
  - e translate between different but equivalent forms of a quadratic function IF.C.8.E
  - f use equivalent forms of a quadratic function to reveal properties of the function IF.C.8.F
  - g use equivalent forms of a quadratic function to explain properties of the function IF.C.8.G
  - h interpret different but equivalent forms of a quadratic function in terms of a context IF.C.8.H
  - i translate between different but equivalent forms of an exponential function IF.C.8.I
  - j use equivalent forms of an exponential function to reveal properties of the function IF.C.8.J
  - k use equivalent forms of an exponential function to explain properties of the function IF.C.8.K
  - l interpret different but equivalent of an exponential function in terms of a context IF.C.8.L
- 9 Compare the properties of two functions given different representations. IF.C.9
- a compare the properties of two linear functions given different representations IF.C.9.A
  - b compare the properties of two quadratic functions given different representations IF.C.9.B
  - c compare the properties of two exponential functions given different representations IF.C.9.C
  - d possible representations IF.C.9.D
    - i function table IF.C.9.D.I
    - ii graph IF.C.9.D.II
    - iii equations in various forms IF.C.9.D.III
  - e possible properties of linear functions IF.C.9.E

- i graph is a straight line IF.C.9.E.I
  - ii graph is not vertical IF.C.9.E.II
  - iii variables are raised to the 1st power IF.C.9.E.III
  - iv rate of change is constant IF.C.9.E.IV
  - f possible properties of quadratic functions IF.C.9.F
    - i graph is a parabola IF.C.9.F.I
    - ii parabola opens up if coefficient  $a > 0$  IF.C.9.F.II
    - iii parabola opens down if coefficient  $a < 0$  IF.C.9.F.III
    - iv coefficient  $a$  cannot be 0 IF.C.9.F.IV
    - v coefficients  $a$ ,  $b$ , and  $c$  are real numbers IF.C.9.F.V
    - vi the discriminant is  $b^2 - 4ac$  IF.C.9.F.VI
    - vii variable is raised to the 2nd power IF.C.9.F.VII
  - g possible properties of exponential functions IF.C.9.G
    - i graph crosses the y-axis at  $(0,1)$  IF.C.9.G.I
    - ii when  $b > 1$ , the graph increases IF.C.9.G.II
    - iii when  $0 < b < 1$ , the graph decreases IF.C.9.G.III
    - iv the domain is all real numbers IF.C.9.G.IV
    - v the range is all positive real numbers IF.C.9.G.V
    - vi graph is asymptotic to the x-axis IF.C.9.G.VI
  - h compare the properties of a linear and a quadratic function given different representations IF.IC.9.H
  - i compare the properties of a quadratic and an exponential function given different representations IF.C.9.I
  - j compare the properties of a linear and an exponential function given different representations IF.C.9.J
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## Building Functions **BF**

### **A Build new functions from existing functions (limited to linear, quadratic and exponential).** **BF.A**

- 1** Analyze the effect of translations and scale changes on functions. **BF.A.1**
    - a** analyze the effect of translations on linear functions **BF.A.1.A**
    - b** analyze the effect of translations on quadratic functions **BF.A.1.B**
    - c** analyze the effect of translations on exponential functions **BF.A.1.C**
    - d** analyze the effect of scale changes on linear functions **BF.A.1.D**
    - e** analyze the effect of scale changes on quadratic functions **BF.A.1.E**
    - f** analyze the effect of scale changes on exponential functions **BF.A.1.F**
    - g** find the specific value of change ( $k$ ) given before and after graphs of a translation **BF.A.1.G**
    - h** find the specific value of change ( $k$ ) given before and after graphs of a scale change **BF.A.1.H**
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## Linear, Quadratic, and Exponential Models LQE

### A Construct and compare linear, quadratic and exponential models and solve problems. LQE.A

- 1 Distinguish between situations that can be modeled with linear or exponential functions. LQE.A.1
  - a determine that linear functions change by equal differences over equal intervals LQE.A.1.A
  - b identify situations that can be modeled with linear functions LQE.A.1.B
  - c determine that exponential functions change by equal factors over equal intervals LQE.A.1.C
  - d determine that situations in which a quantity grows by a constant percent rate per unit interval are exponential functions LQE.A.1.D
  - e determine that situations in which a quantity decays by a constant percent rate per unit interval are exponential functions LQE.A.1.E
  - f identify situations that can be modeled with exponential functions LQE.A.1.F
  - g distinguish between situations that can be modeled with linear or exponential functions LQE.A.1.G
- 2 Describe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically. LQE.A.2
  - a using a graph, describe that a quantity increasing exponentially eventually exceeds a quantity increasing linearly LQE.A.2.A
  - b using a graph, describe that a quantity increasing exponentially eventually exceeds a quantity increasing quadratically LQE.A.2.B
  - c using a table, describe that a quantity increasing exponentially eventually exceeds a quantity increasing linearly LQE.A.2.C
  - d using a table, describe that a quantity increasing exponentially eventually exceeds a quantity increasing quadratically LQE.A.2.D
- 3 Construct linear, quadratic and exponential equations given graphs, verbal descriptions or tables. LQE.A.3
  - a construct a linear equation given a graph LQE.A.3.A
  - b construct a linear equation given a verbal description LQE.A.3.B
  - c construct a linear equation given a table LQE.A.3.C
  - d construct a quadratic equation given a graph LQE.A.3.D
  - e construct a quadratic equation given a verbal description LQE.A.3.E
  - f construct a quadratic equation given a table LQE.A.3.F
  - g construct an exponential equation given a graph LQE.A.3.G
  - h construct an exponential equation given a verbal description LQE.A.3.H
  - i construct an exponential equation given a table LQE.A.3.I
  - j given a graph, determine whether to construct a linear, quadratic, or exponential equation LQE.A.3.J

- k given a verbal description, determine whether to construct a linear, quadratic, or exponential equation **LQE.A.3.K**
- l given a table, determine whether to construct a linear, quadratic, or exponential equation **LQE.A.3.L**

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**B Use arithmetic and geometric sequences.** LQE.B

- 4 Write arithmetic and geometric sequences in recursive and explicit forms, and use them to model situations and translate between the two forms. LQE.B.4
  - a determine whether a sequence is arithmetic or geometric LQE.B.4.A
  - b use arithmetic sequences in recursive form LQE.B.4.B
  - c use arithmetic sequences in explicit form LQE.B.4.C
  - d connect arithmetic sequences to linear functions LQE.B.4.D
  - e use geometric sequences in recursive form LQE.B.4.E
  - f use geometric sequences in explicit form LQE.B.4.F
  - g connect geometric sequences to exponential functions LQE.B.4.G
  - h write recursive form of an arithmetic sequence to model a situation given graphically LQE.B.4.H
  - i write recursive form of an arithmetic sequence to model a situation given by verbal description LQE.B.4.I
  - j write recursive form of an arithmetic sequence to model a situation given in a table LQE.B.4.J
  - k write explicit form of an arithmetic sequence to model a situation given graphically LQE.B.4.K
  - l write explicit form of an arithmetic sequence to model a situation given by verbal description LQE.B.4.L
  - m write explicit form of an arithmetic sequence to model a situation given in a table LQE.B.4.M
  - n write recursive form of a geometric sequence to model a situation given graphically LQE.B.4.N
  - o write recursive form of a geometric sequence to model a situation given by verbal description LQE.B.4.O
  - p write recursive form of a geometric sequence to model a situation given in a table LQE.B.4.P
  - q write explicit form of a geometric sequence to model a situation given graphically LQE.B.4.Q
  - r write explicit form of a geometric sequence to model a situation given by verbal description LQE.B.4.R
  - s write explicit form of a geometric sequence to model a situation given in a table LQE.B.4.S
  - t translate between recursive and explicit forms of arithmetic sequences LQE.B.4.T
  - u translate between recursive and explicit forms of geometric sequences LQE.B.4.U
  - v model situations with arithmetic sequences LQE.B.4.V

- i recognize LQE.B.4.V.I
    - ii generate LQE.B.4.V.II
  - w model situations with geometric sequences LQE.B.4.W
  - i recognize LQE.B.4.W.I
    - ii generate LQE.B.4.W.II
  - 5 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the set of integers. LQE.B.5
    - a recognize that arithmetic sequences are functions LQE.B.5.A
    - b recognize that arithmetic sequences are sometimes defined recursively LQE.B.5.B
    - c recognize that the domain of an arithmetic sequence is a subset of the set of integers LQE.B.5.C
    - d recognize that geometric sequences are functions LQE.B.5.D
    - e recognize that geometric sequences are sometimes defined recursively LQE.B.5.E
    - f recognize that the domain of a geometric sequence is a subset of the set of integers LQE.B.5.F
  - 6 Find the terms of sequences given an explicit or recursive formula. LQE.B.6
    - a find the terms of an arithmetic sequence given an explicit formula LQE.B.6.A
    - b find the terms of an arithmetic sequence given a recursive formula LQE.B.6.B
    - c find the terms of a geometric sequence given an explicit formula LQE.B.6.C
    - d find the terms of a geometric sequence given a recursive formula LQE.B.6.D
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## Number and Quantity **NQ**

### **A Extend and use properties of rational exponents.** **NQ.A**

- 1** Explain how the meaning of rational exponents extends from the properties of integer exponents. **NQ.A.1**
  - a** explain the meaning of rational exponents **NQ.A.1.A**
  - b** identify the properties of integer exponents **NQ.A.1.B**
    - i** product of powers property **NQ.A.1.B.I**
    - ii** power of a power property **NQ.A.1.B.II**
    - iii** power of a product property **NQ.A.1.B.III**
    - iv** quotient of powers property **NQ.A.1.B.IV**
    - v** power of a quotient property **NQ.A.1.B.V**
    - vi** zero power property **NQ.A.1.B.VI**
    - vii** negative power property **NQ.A.1.B.VII**
  - c** explain how the meaning of rational exponents extends from the properties of integer exponents **NQ.A.1.C**
- 2** Rewrite expressions involving radicals and rational exponents using the properties of exponents. Limit to rational exponents with a numerator of 1. **NQ.A.2**
  - a** identify the properties of exponents **NQ.A.2.A**
  - b** rewrite expressions involving radicals using the properties of exponents **NQ.A.2.B**
  - c** rewrite expressions involving rational exponents (limit to a numerator of 1) using the properties of exponents **NQ.A.2.C**

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**B Use units to solve problems.** NQ.B

- 3 Use units of measure as a way to understand and solve problems involving quantities. NQ.B.3
- a use units of measure as a way to understand problems involving quantities NQ.B.3.A
  - b use units of measure as a way to solve problems involving quantities NQ.B.3.B
  - c identify appropriate units of measure within a problem NQ.B.3.C
  - d label appropriate units of measure within a problem NQ.B.3.D
  - e use appropriate units of measure within a problem NQ.B.3.E
  - f convert units NQ.B.3.F
  - g convert rates NQ.B.3.G
  - h use units with problems NQ.B.3.H
  - i choose a scale in a graph NQ.B.3.I
  - j interpret the scale in a graph NQ.B.3.J
  - k choose an origin in a graph NQ.B.3.K
  - l interpret an origin in a graph NQ.B.3.L
  - m choose a scale in a data display NQ.B.3.M
  - n interpret the scale in a data display NQ.B.3.N
  - o choose an origin in a data display NQ.B.3.O
  - p interpret an origin in a data display NQ.B.3.P
- 4 Define and use appropriate quantities for representing a given context or problem. NQ.B.4
- a define appropriate quantities for representing a given context NQ.B.4.A
  - b define appropriate quantities for representing a given problem NQ.B.4.B
  - c use appropriate quantities for representing a given context NQ.B.4.C
  - d use appropriate quantities for representing a given problem NQ.B.4.D
- 5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. NQ.B.5
- a choose a level of accuracy appropriate to limitations on measurement when reporting quantities NQ.B.5.A
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## Data and Statistical Analysis DS

### A Summarize, represent and interpret data. DS.A

- 1 Analyze and interpret graphical displays of data. DS.A.1
  - a analyze a dot plot DS.A.1.A
  - b interpret a dot plot DS.A.1.B
  - c analyze a histogram DS.A.1.C
  - d interpret a histogram DS.A.1.D
  - e analyze a box plot DS.A.1.E
  - f interpret a box plot DS.A.1.F
- 2 Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets. DS.A.2
  - a determine statistics appropriate to the shape of a data distribution DS.A.2.A
  - b use statistics appropriate to the shape of a data distribution to compare median of two or more different data sets DS.A.2.B
  - c use statistics appropriate to the shape of a data distribution to compare mean of two or more different data sets DS.A.2.C
  - d use statistics appropriate to the shape of a data distribution to compare mode of two or more different data sets DS.A.2.D
  - e use statistics appropriate to the shape of a data distribution to compare interquartile range of two or more different data sets DS.A.2.E
  - f use statistics appropriate to the shape of a data distribution to compare standard deviation of two or more different data sets DS.A.2.F
  - g calculate statistics appropriate to the shape of a data distribution to compare standard deviation of two or more different data sets DS.A.2.G
- 3 Interpret differences in shape, center and spreads in the context of the data sets, accounting for possible effects of outliers. DS.A.3
  - a identify differences in shape of up to three data sets DS.A.3.A
  - b identify differences in center of up to three data sets DS.A.3.B
  - c identify differences in spreads of up to three data sets DS.A.3.C
  - d interpret differences in shape in the context of the data sets, accounting for possible effects of outliers DS.A.3.D
  - e interpret differences in center in the context of the data sets, accounting for possible effects of outliers DS.A.3.E
  - f interpret differences in spreads in the context of the data sets, accounting for possible effects of outliers DS.A.3.F
- 4 Summarize data in two-way frequency tables. DS.A.4
  - a identify frequencies in the data in two-way frequency tables DS.A.4.A
  - b interpret relative frequencies in the context of the data in a two-way frequency table DS.A.4.B

- c recognize possible associations in the data in a two-way frequency table **DS.A.4.C**
      - d recognize possible trends in the data in a two-way frequency table **DS.A.4.D**
- 5 Construct a scatter plot of bivariate quantitative data describing how the variables are related; determine and use a function that models the relationship. **DS.A.5**
  - a construct a scatter plot of bivariate quantitative data **DS.A.5.A**
  - b use the scatter plot to determine the type of function that models the relationship **DS.A.5.B**
  - c construct a linear function to model bivariate data on a scatter plot **DS.A.5.C**
    - i minimize residuals using calculation **DS.A.5.C.I**
    - ii minimize residuals using technology **DS.A.5.C.II**
  - d construct an exponential function to model bivariate data on a scatter plot **DS.A.5.D**
    - i minimize residuals using calculation **DS.A.5.D.I**
    - ii minimize residuals using technology **DS.A.5.D.II**
- 6 Interpret the slope (rate of change) and the y-intercept (constant term) of a linear model in the context of the data. **DS.A.6**
  - a identify the slope of a linear model **DS.A.6.A**
  - b interpret the slope of a linear model as rate of change **DS.A.6.B**
  - c interpret the slope of a linear model in the context of the data **DS.A.6.C**
  - d identify the y-intercept of a linear model **DS.A.6.D**
  - e interpret the y-intercept of a linear model as a constant term **DS.A.6.E**
  - f interpret the y-intercept of a linear model in the context of the data **DS.A.6.F**
- 7 Determine and interpret the correlation coefficient for a linear association. **DS.A.7**
  - a determine the correlation coefficient for a linear association **DS.A.7.A**
  - b interpret the correlation coefficient for a linear association **DS.A.7.B**
- 8 Distinguish between correlation and causation. **DS.A.8**
  - a distinguish between correlation and causation **DS.A.8.A**
  - b distinguish between strong correlation and causation **DS.A.8.B**