

Apex Learning® Tutorials provide teachers with a solution to support all students in rising to the expectations established by Illinois Learning Standards (ILS). Tutorials offer direct instruction, practice, review, and assessment to build the knowledge and skills required to prepare students for PARCC assessments and the Illinois Science Assessment (ISA).

Math Tutorials offer targeted instruction, practice and review designed to develop computational fluency, deepen conceptual understanding, and apply mathematical practices. They automatically identify and address learning gaps down to elementary-level content, using adaptive remediation to bring students to grade-level no matter where they start. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By constantly honing the ability to apply their knowledge in abstract and real world scenarios, students build the depth of knowledge and higher order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students through focused content, modeled logic and process, multi-modal representations, and personalized feedback as students reason through increasingly challenging problems. The Review It offers a high impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

## 1. EXPRESSIONS, EQUATIONS, AND INEQUALITIES

### ● ONE-STEP EQUATIONS AND INEQUALITIES

- **CCSS.Math.Content.HSA-CED.A.1** Create equations and inequalities in one variable and use them to solve problems.
- **CCSS.Math.Content.HSA-REI.A.1** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- **CCSS.Math.Content.HSA-REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- **CCSS.Math.Content.HSF-BF.A.1a** Determine an explicit expression, a recursive process, or steps for calculation from a context.

### ● MULTI-STEP EQUATIONS AND INEQUALITIES

- **CCSS.Math.Content.HSA-CED.A.1** Create equations and inequalities in one variable and use them to solve problems.
- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSA-REI.A.1** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- **CCSS.Math.Content.HSA-REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

### ● AXIOMS OF EQUALITY

- **CCSS.Math.Content.HSA-SSE.A.2** Use the structure of an expression to identify ways to rewrite it.
- **CCSS.Math.Content.HSA-REI.A.1** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

### ● LITERAL EQUATIONS

- **CCSS.Math.Content.HSA-CED.A.1** Create equations and inequalities in one variable and use them to solve problems.

- **CCSS.Math.Content.HSA-REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- **CCSS.Math.Content.HSA-CED.A.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

## 2. WRITING EQUATIONS AND INEQUALITIES

### ● FORMULATING AND SOLVING EQUATIONS FROM WORD PROBLEMS

- **CCSS.Math.Content.HSA-CED.A.1** Create equations and inequalities in one variable and use them to solve problems.
- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSA-SSE.A.1a** Interpret parts of an expression, such as terms, factors, and coefficients.
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-BF.A.1a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **CCSS.Math.Content.HSF-LE.A.1b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- **CCSS.Math.Content.HSF-IF.B.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

### ● FORMULATING AND SOLVING INEQUALITIES FROM WORD PROBLEMS

- **CCSS.Math.Content.HSA-CED.A.1** Create equations and inequalities in one variable and use them to solve problems.
- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSA-REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- **CCSS.Math.Content.HSA-SSE.A.1a** Interpret parts of an expression, such as terms, factors, and coefficients.
- **CCSS.Math.Content.HSA-SSE.A.1b** Interpret complicated expressions by viewing one or more of their parts as a single entity.

## 3. FUNCTIONS

### ● FUNCTIONS AND RELATIONS

- **CCSS.Math.Content.HSF-IF.A.2** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-IF.B.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-IF.C.7b** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

### ● DOMAIN AND RANGE

- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-IF.B.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

## ● EVALUATING FUNCTIONS

- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-IF.A.2** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- **CCSS.Math.Content.HSF-BF.A.1a** Determine an explicit expression, a recursive process, or steps for calculation from a context.

## 4. GRAPHING LINEAR EQUATIONS AND INEQUALITIES

### ● GRAPHING AND ANALYZING LINEAR FUNCTIONS

- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-IF.B.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **CCSS.Math.Content.HSF-IF.B.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- **CCSS.Math.Content.HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- **CCSS.Math.Content.HSF-IF.C.7a** Graph linear and quadratic functions and show intercepts, maxima, and minima.

### ● GRAPHING AND MANIPULATING $Y = MX + B$

- **CCSS.Math.Content.HSA-CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-IF.C.7a** Graph linear and quadratic functions and show intercepts, maxima, and minima.
- **CCSS.Math.Content.HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- **CCSS.Math.Content.HSS-ID.C.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- **CCSS.Math.Content.HSF-IF.B.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- **CCSS.Math.Content.HSF-LE.A.1b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- **CCSS.Math.Content.HSF-LE.B.5** Interpret the parameters in a linear or exponential function in terms of a context.

### ● GRAPHS OF LINEAR INEQUALITIES

- **CCSS.Math.Content.HSA-REI.D.12** Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
- **CCSS.Math.Content.HSA-REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.

## 5. LINEAR EQUATIONS

### • SLOPE

- **CCSS.Math.Content.HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-IF.B.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- **CCSS.Math.Content.HSG-GPE.B.5** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

### • SLOPE-INTERCEPT FORM OF A LINEAR EQUATION

- **CCSS.Math.Content.HSS-ID.C.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-IF.C.7a** Graph linear and quadratic functions and show intercepts, maxima, and minima.
- **CCSS.Math.Content.HSA-REI.D.10** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- **CCSS.Math.Content.HSG-GPE.B.5** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
- **CCSS.Math.Content.HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

### • POINT-SLOPE FORM OF A LINEAR EQUATION

- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSA-REI.D.10** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- **CCSS.Math.Content.HSF-IF.C.7a** Graph linear and quadratic functions and show intercepts, maxima, and minima.
- **CCSS.Math.Content.HSG-GPE.B.5** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

## 6. POINTS, LINES, AND ANGLES

### • POINTS, RAYS, LINE SEGMENTS, LINES, AND FIGURES

- **CCSS.Math.Content.HSG-CO.A.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

- **CCSS.Math.Content.HSG-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

- **PARALLEL AND PERPENDICULAR LINES**

- **CCSS.Math.Content.HSG-CO.A.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
- **CCSS.Math.Content.HSG-GPE.B.5** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

## 7. COORDINATE GEOMETRY

- **LENGTH AND THE DISTANCE FORMULA**

- **CCSS.Math.Content.HSG-GPE.B.6** Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
- **CCSS.Math.Content.HSG-GPE.B.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
- **CCSS.Math.Content.HSG-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **CCSS.Math.Content.HSG-CO.A.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

- **PERIMETER ON THE COORDINATE PLANE**

- **CCSS.Math.Content.HSG-GPE.B.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
- **CCSS.Math.Content.HSG-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **CCSS.Math.Content.HSG-GPE.B.4** Use coordinates to prove simple geometric theorems algebraically.

- **AREA ON THE COORDINATE PLANE**

- **CCSS.Math.Content.HSG-GPE.B.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
- **CCSS.Math.Content.HSG-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

- **CONJECTURES IN COORDINATE GEOMETRY**

- **CCSS.Math.Content.HSG-CO.A.2** Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
- **CCSS.Math.Content.HSG-CO.C.10** Prove theorems about triangles.
- **CCSS.Math.Content.HSG-GPE.B.4** Use coordinates to prove simple geometric theorems algebraically.

## 8. TRANSFORMATIONS AND CONGRUENCE

- **DILATIONS, TRANSLATIONS, ROTATIONS, AND REFLECTIONS**

- **CCSS.Math.Content.HSG-CO.A.5** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
- **CCSS.Math.Content.HSG-CO.B.6** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- **CCSS.Math.Content.HSG-CO.A.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- **CCSS.Math.Content.HSG-CO.A.2** Represent transformations in the plane using, e.g., transparencies and geometry

software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

- **CCSS.Math.Content.HSG-CO.A.4** Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
- **CCSS.Math.Content.HSG-SRT.A.2** Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- **CCSS.Math.Content.HSG-SRT.A.1a** A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
- **CCSS.Math.Content.HSG-SRT.A.1b** The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

## ● TRANSFORMATIONS ON THE COORDINATE PLANE

- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSG-CO.A.2** Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
- **CCSS.Math.Content.HSG-CO.A.5** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
- **CCSS.Math.Content.HSG-CO.B.6** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- **CCSS.Math.Content.HSG-CO.A.4** Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
- **CCSS.Math.Content.HSG-CO.A.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- **CCSS.Math.Content.HSG-SRT.A.1b** The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
- **CCSS.Math.Content.HSG-SRT.A.2** Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- **CCSS.Math.Content.HSG-SRT.A.1a** A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.

## ● TRIANGLES AND CONGRUENCE TRANSFORMATIONS

- **CCSS.Math.Content.HSG-CO.B.6** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- **CCSS.Math.Content.HSG-CO.B.7** Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
- **CCSS.Math.Content.HSG-CO.B.8** Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- **CCSS.Math.Content.HSG-CO.C.10** Prove theorems about triangles.
- **CCSS.Math.Content.HSG-SRT.B.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

## ● CONGRUENCE OF OTHER POLYGONS

- **CCSS.Math.Content.HSG-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **CCSS.Math.Content.HSG-CO.A.5** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
- **CCSS.Math.Content.HSG-CO.B.6** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to

decide if they are congruent.

- **CCSS.Math.Content.HSG-CO.A.2** Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
- **CCSS.Math.Content.HSG-CO.A.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

## 9. LINEAR SYSTEMS

### ● SOLVING SYSTEMS OF LINEAR EQUATIONS: GUESS AND CHECK

- **CCSS.Math.Content.HSA-CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSF-BF.A.1a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **CCSS.Math.Content.HSA-REI.C.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

### ● SOLVING SYSTEMS OF LINEAR EQUATIONS: GRAPHING

- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSA-REI.C.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
- **CCSS.Math.Content.HSA-REI.D.11** Explain why the  $x$ -coordinates of the points where the graphs of the equations  $y = f(x)$  and  $y = g(x)$  intersect are the solutions of the equation  $f(x) = g(x)$ ; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where  $f(x)$  and/or  $g(x)$  are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
- **CCSS.Math.Content.HSA-CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

### ● SOLVING SYSTEMS OF LINEAR EQUATIONS: SUBSTITUTION

- **CCSS.Math.Content.HSA-CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSA-REI.C.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
- **CCSS.Math.Content.HSA-REI.C.5** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

### ● SOLVING SYSTEMS OF LINEAR EQUATIONS: ELIMINATION

- **CCSS.Math.Content.HSA-CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSA-REI.C.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
- **CCSS.Math.Content.HSA-REI.C.5** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

## 10. WORKING WITH FUNCTIONS

### ● LINEAR VERSUS NONLINEAR FUNCTIONS

- **CCSS.Math.Content.HSF-IF.C.9** Compare properties of two functions each represented in a different way (algebraically,

graphically, numerically in tables, or by verbal descriptions).

- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-LE.A.1a** Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
- **CCSS.Math.Content.HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- **CCSS.Math.Content.HSF-LE.A.1c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- **CCSS.Math.Content.HSF-LE.A.1b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- **CCSS.Math.Content.HSF-IF.B.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

## ● LINEAR AND EXPONENTIAL PARENT FUNCTIONS

- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSA-REI.D.10** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-IF.B.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **CCSS.Math.Content.HSF-IF.B.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- **CCSS.Math.Content.HSF-IF.C.7e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
- **CCSS.Math.Content.HSF-LE.A.1c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

## ● TRANSFORMATIONS OF THE LINEAR AND EXPONENTIAL PARENT FUNCTIONS

- **CCSS.Math.Content.HSF-BF.B.3** Identify the effect on the graph of replacing  $f(x)$  by  $f(x) + k$ ,  $k f(x)$ ,  $f(kx)$ , and  $f(x + k)$  for specific values of  $k$  (both positive and negative); find the value of  $k$  given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.
- **CCSS.Math.Content.HSG-CO.A.2** Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
- **CCSS.Math.Content.HSG-CO.B.6** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

## 11. EXPONENTIAL FUNCTIONS, EQUATIONS, AND INEQUALITIES

### ● EXPONENTIAL FUNCTIONS

- **CCSS.Math.Content.HSA-SSE.A.1a** Interpret parts of an expression, such as terms, factors, and coefficients.
- **CCSS.Math.Content.HSA-SSE.A.1b** Interpret complicated expressions by viewing one or more of their parts as a single entity.
- **CCSS.Math.Content.HSF-IF.B.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- **CCSS.Math.Content.HSF-IF.C.8b** Use the properties of exponents to interpret expressions for exponential functions.
- **CCSS.Math.Content.HSF-LE.A.1a** Prove that linear functions grow by equal differences over equal intervals, and that



exponential functions grow by equal factors over equal intervals.

- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- **CCSS.Math.Content.HSF-LE.A.3** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- **CCSS.Math.Content.HSF-IF.A.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- **CCSS.Math.Content.HSF-IF.B.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **CCSS.Math.Content.HSF-IF.C.7e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
- **CCSS.Math.Content.HSA-CED.A.1** Create equations and inequalities in one variable and use them to solve problems.
- **CCSS.Math.Content.HSA-CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **CCSS.Math.Content.HSA-REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- **CCSS.Math.Content.HSA-SSE.B.3c** Use the properties of exponents to transform expressions for exponential functions.
- **CCSS.Math.Content.HSF-BF.A.1a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **CCSS.Math.Content.HSF-LE.B.5** Interpret the parameters in a linear or exponential function in terms of a context.
- **CCSS.Math.Content.HSF-LE.A.1c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

## • EXPONENTIAL GROWTH AND DECAY

- **CCSS.Math.Content.HSA-SSE.A.1a** Interpret parts of an expression, such as terms, factors, and coefficients.
- **CCSS.Math.Content.HSA-SSE.A.1b** Interpret complicated expressions by viewing one or more of their parts as a single entity.
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-IF.C.8b** Use the properties of exponents to interpret expressions for exponential functions.
- **CCSS.Math.Content.HSF-LE.A.1a** Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
- **CCSS.Math.Content.HSF-LE.B.5** Interpret the parameters in a linear or exponential function in terms of a context.
- **CCSS.Math.Content.HSF-LE.A.1c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- **CCSS.Math.Content.HSA-CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **CCSS.Math.Content.HSF-LE.A.3** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- **CCSS.Math.Content.HSF-LE.A.1b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

## • SOLVING EXPONENTIAL INEQUALITIES

- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSA-CED.A.1** Create equations and inequalities in one variable and use them to solve problems.
- **CCSS.Math.Content.HSA-CED.A.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **CCSS.Math.Content.HSA-CED.A.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- **CCSS.Math.Content.HSA-SSE.A.1b** Interpret complicated expressions by viewing one or more of their parts as a single entity.

- **CCSS.Math.Content.HSF-LE.A.1c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

## 12. SEQUENCES

### • SEQUENCES

- **CCSS.Math.Content.HSF-BF.A.1a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **CCSS.Math.Content.HSF-IF.A.3** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- **CCSS.Math.Content.HSF-BF.A.2** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

### • ARITHMETIC AND GEOMETRIC SEQUENCES

- **CCSS.Math.Content.HSF-BF.A.2** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
- **CCSS.Math.Content.HSF-LE.A.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **CCSS.Math.Content.HSF-BF.A.1a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **CCSS.Math.Content.HSF-IF.A.3** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.

## 13. STATISTICS

### • DATA ANALYSIS

- **CCSS.Math.Content.HSS-ID.A.1** Represent data with plots on the real number line (dot plots, histograms, and box plots).
- **CCSS.Math.Content.HSS-ID.A.3** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- **CCSS.Math.Content.HSS-ID.A.2** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

### • FREQUENCY TABLES

- **CCSS.Math.Content.HSS-ID.B.5** Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
- **CCSS.Math.Content.HSS-CP.A.4** Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.
- **CCSS.Math.Content.HSS-ID.A.3** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

### • SCATTERPLOTS

- **CCSS.Math.Content.HSS-ID.B.6a** Fit a function to the data; use functions fitted to data to solve problems in the context of the data.
- **CCSS.Math.Content.HSS-ID.B.6b** Informally assess the fit of a function by plotting and analyzing residuals.
- **CCSS.Math.Content.HSS-ID.B.6c** Fit a linear function for a scatter plot that suggests a linear association.
- **CCSS.Math.Content.HSS-ID.C.9** Distinguish between correlation and causation.
- **CCSS.Math.Content.HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- **CCSS.Math.Content.HSS-ID.C.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

- **SCATTERPLOTS AND MODELING**

- **CCSS.Math.Content.HSS-ID.B.6a** *Fit a function to the data; use functions fitted to data to solve problems in the context of the data.*
- **CCSS.Math.Content.HSS-ID.B.6b** *Informally assess the fit of a function by plotting and analyzing residuals.*
- **CCSS.Math.Content.HSS-ID.C.8** *Compute (using technology) and interpret the correlation coefficient of a linear fit.*
- **CCSS.Math.Content.HSS-ID.B.6c** *Fit a linear function for a scatter plot that suggests a linear association.*
- **CCSS.Math.Content.HSS-ID.C.7** *Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*
- **CCSS.Math.Content.HSF-LE.A.1a** *Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.*
- **CCSS.Math.Content.HSF-LE.A.1c** *Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.*

## 14. TOPICS IN GEOMETRY

- **MONITORING PRECISION AND ACCURACY**

- **CCSS.Math.Content.HSN-Q.A.1** *Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*
- **CCSS.Math.Content.HSN-Q.A.2** *Define appropriate quantities for the purpose of descriptive modeling.*
- **CCSS.Math.Content.HSN-Q.A.3** *Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

- **CONSTRUCTIONS**

- **CCSS.Math.Content.HSG-CO.D.12** *Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).*
- **CCSS.Math.Content.HSG-CO.D.13** *Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.*
- **CCSS.Math.Content.HSG-C.A.4** *Construct a tangent line from a point outside a given circle to the circle.*