

Agile Mind Intensified Algebra I Scope and Sequence, 2015-2016

Common Core State Standards for Mathematics

Agile Mind Topics	Time allotment (1 lesson = 80 minutes) *Topic includes optional extension or review lesson	Topic Descriptions	Common Core State Standards for Mathematics <ul style="list-style-type: none"> Standards in black are the primary instructional focus of the topic. Standards in gray support topic content or indicate foundations for future work.
<p>Opportunities for students to apply the practices of making sense of problems and persevere in solving them, reasoning abstractly and quantitatively, constructing viable arguments, modeling with mathematics, using appropriate tools strategically, attending to precision, looking for and making use of structure, and looking for and expressing regularity in repeated reasoning are evident throughout this course. (Standards for Mathematical Practice)</p> <p>Because Intensified Algebra I incorporates review and repair strategies for pre-algebra concepts and skills, standards prior to Algebra I have been included.</p>			
Unit 1: Getting started with Algebra			
1: Exploring problem-solving strategies	5 lessons	<p>Students experience collaboration as a strategy to solve problems. They share problem-solving strategies as they explore problems that have one or more solutions.</p> <p>Shaping attitudes toward learning:</p> <ul style="list-style-type: none"> Students learn about their teacher, their classmates, and this course; Students learn strategies for being effective communicators; Students learn and practice norms and routines to aid collaboration and overall learning. <p>Focus Skill work:</p> <ul style="list-style-type: none"> Operations with signed numbers Addition Subtraction 	<p>6-NS.6a: Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself.</p> <p>6-NS.7c: Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation.</p> <p>7-NS.1a: Describe situations in which opposite quantities combine to make 0.</p> <p>7-NS.1b: Understand $p + q$ as the number located a distance q from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.</p> <p>7-NS.1c: Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.</p> <p>7-NS.1d: Apply properties of operations as strategies to add and subtract rational numbers.</p> <p>7-EE.3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p>
2: Getting smarter through algebraic reasoning	5 lessons	<p>This topic introduces students to the ideas of malleable intelligence and brain growth through learning. Students continue to develop problem-solving strategies as they extend their understanding of patterns.</p> <p>Shaping attitudes toward learning:</p> <ul style="list-style-type: none"> Students examine and reflect on the perceptions of their math ability; Students learn how intelligence is 	<p>7-NS.2a: Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.</p> <p>7-NS.2b: Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts.</p> <p>7-NS.2c: Apply properties of operations as strategies to multiply and divide rational numbers.</p> <p>7-EE.3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as</p>

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		<p>malleable, not fixed;</p> <ul style="list-style-type: none"> • Students understand how working on challenging problems affects the brain. <p>Focus Skill work:</p> <ul style="list-style-type: none"> • Operations with signed numbers • Multiplication • Division 	<p>appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p> <p>N-Q.2: Define appropriate quantities for the purpose of descriptive modeling.</p>
3: Foundations of algebra	10 lessons	<p>Students investigate the use of variables to represent unknowns and to generalize relationships. They also review important graphing skills.</p>	<p>6-EE.2a: Write expressions that record operations with numbers and with letters standing for numbers.</p> <p>6-EE.2c: Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole- number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).</p> <p>6-EE.3: Apply the properties of operations to generate equivalent expressions.</p> <p>6-EE.4: Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them).</p> <p>6-EE.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7-EE.1: Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.</p> <p>7-EE.4a: Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. <i>For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width? .</i></p> <p>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).</p> <p>F-BF.1a: Determine an explicit expression, a recursive process, or steps for calculation from a context.</p> <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 $y = f(x)$.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A-SSE.2: Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.</p>

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Unit 2: Introduction to functions and equations			
4: Representing mathematical relationships in multiple ways	6-7 lessons*	<p>This topic begins a key theme of the course: Relationships between variables can be represented using words, tables, graphs, or symbols. Students are formally introduced to different ways to represent patterns and relationships and begin to connect various representations of proportional and non-proportional situations to one another (verbal, numeric, graphical, algebraic). They also extend their understanding of multiple representations in a way that will pay big dividends in Algebra I: They begin to learn to generate other, related representations when given a single representation of a pattern or relationship.</p>	<p>6-EE.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>6-EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, though of as the dependent variable, in terms of the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. <i>For example, in a problem involving motion at a constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i></p> <p>F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A-SSE.1b: Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.</i></p>
5: Problem solving and metacognition	5 lessons	<p>Students further develop their problem-solving capabilities and their algebraic thinking by working on a non-routine problem. Students also explicitly explore the use of metacognitive strategies to improve their problem solving and learning.</p> <p>Shaping attitude toward learning:</p> <ul style="list-style-type: none"> • Students understand the roles of confusion and metacognition in the learning process. <p>Focus Skill work: Scaling graph axes.</p>	<p>6-EE.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>6-EE.9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, though of as the dependent variable, in terms of the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. <i>For example, in a problem involving motion at a constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i></p> <p>N-Q.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.</p>
6: Working with functions and equations	7-8 lessons*	<p>Students are informally introduced to the concept of function as a dependency relationship between two variables, in which one depends on the other in a systematic way. Students extend their growing understanding of multiple representations and use them to represent functions involving proportional and non-proportional linear relationships algebraically, numerically, graphically and verbally.</p>	<p>6-EE.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>6-EE.9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, though of as the dependent variable, in terms of the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. <i>For example, in a problem involving motion at a constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i></p> <p>7-RP.2a: Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.</p> <p>7-RP.2b: Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and</p>

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			<p>verbal descriptions of proportional relationships.</p> <p>7-RP.2c: Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.</p> <p>7-RP.2d: Explain what a point (x,y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0,0)$ and $(1, r)$ where r is the unit rate.</p> <p>8-EE.5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.</p> <p>8-F.1: Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.</p> <p>N-Q.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>A-CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A-CED.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.</p> <p>A-REI.10: Understand that the graph of an equation in two variables is the set of all its solution plotted in the coordinate plane, often forming a curve (which could be a line).</p> <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 $y = f(x)$.</p> <p>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.</p> <p>F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>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.*</i></p> <p>F-IF.7b: Graph square root, cube root, and piecewise defined functions, including absolute value functions.</p>
Unit 3: Rate of change			
7: Exploring rate of change in motion problems	8 lessons	Understanding the rate at which one quantity changes with respect to another is key to understanding how the two quantities are related. In this topic, students explore the concept of rate by analyzing motion over time. Students investigate the rate at which distance changes numerically and graphically.	<p>8-F.5: Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.</p> <p>N-Q.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>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.*</i></p> <p>F-IF.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.*</p>

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			<p>F-LE.1b: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</p>
8: Mindset, motivation, and algebraic thinking	5 lessons	<p>Students further develop their problem-solving capabilities and algebraic thinking by working on a non-routine problem. Students reflect on their mindset as they work on the problem, and learn that mindset can affect success.</p> <p>Shaping attitudes toward learning:</p> <ul style="list-style-type: none"> • Students learn what is meant by the term mindset and how mindsets can affect success; • Students develop strategies to maintain a positive mindset; • Students understand that maintaining motivation while engaged in learning tasks can result in more effective effort; • Students recognize that setting goals can help maintain motivation; • Students set useful goals. <p>Focus Skill work: Working with unit rates.</p>	<p>6-RP.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6-RP.2: Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.</p> <p>7-RP.1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.</p> <p>7-RP.2a: Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.</p> <p>7-RP.2b: Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.</p>
9: Exploring rate of change in other situations	7 lessons	<p>This topic deepens student understanding of the central ideas of rate of change. Students discover that they can model data sets that have a constant rate of change with a linear function. Students also learn that not all data are linear, and thus require other models.</p>	<p>7-RP.2a: Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.</p> <p>8-EE.5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.</p> <p>8-F.2: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).</p> <p>8-F.4: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</p> <p>N-Q.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.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>F-IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a</p>

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			table) over a specified interval. Estimate the rate of change from a graph.* F-LE.1b: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
Unit 4: Linear functions			
10: Understanding slope and intercepts	8 lessons	This topic relates the constant rate of change of a linear function, the slope of the line that is the linear function's graph, and the value of m in the linear function rule $y = mx + b$. Students explore this connection using tables, graphs, and function rules. It also develops students' understanding of the x - and y -intercepts of the graph of a linear model and the relationship between the intercepts and the situation being modeled. Students learn to find the values of the intercepts directly from linear function rules expressed in slope intercept form ($y = mx + b$) or standard form ($Ax + By = C$).	<p>6-EE.9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, though of as the dependent variable, in terms of the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. <i>For example, in a problem involving motion at a constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i></p> <p>8-EE.6: Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.</p> <p>8-F.3: Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.</p> <p>8-F.4: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>F-IF.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.*</p> <p>F-IF.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>F-IF.7b: Graph square root, cube root, and piecewise defined functions, including absolute value functions.</p> <p>F-IF.9: Compare properties of two functions each represented in a different way.</p> <p>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 positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.</p> <p>F-LE.1a: Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.</p> <p>F-LE.1b: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</p> <p>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).</p> <p>F-LE.5: Interpret the parameters in a linear or exponential function in terms of a context.</p> <p>S-ID.07: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.</p>

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<p>11: Working with equations of lines in different forms</p>	<p>3 lessons</p>	<p>Students work a variety of problems that emphasize writing linear equations in different forms.</p> <p>Focus Skill work: Writing and analyzing various forms of equations of lines including standard form, slope-intercept form, and point-slope form while practicing the distributive property and collecting like terms.</p>	<p>6-EE.3: Apply the properties of operations to generate equivalent expressions.</p> <p>6-EE.9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, though of as the dependent variable, in terms of the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. <i>For example, in a problem involving motion at a constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i></p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>F-IF.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>F-BF.1a: Determine an explicit expression, a recursive process, or steps for calculation from a context.</p> <p>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).</p> <p>F-LE.5: Interpret the parameters in a linear or exponential function in terms of a context.</p>
<p>12: Creating linear models for data</p>	<p>7 lessons</p>	<p>This topic revisits analyzing rate of change to determine whether using a linear model to represent data is appropriate. It also develops the point-slope form for the equation of a line, explicitly connects the point-slope and slope intercept forms, and introduces students to the idea of transformations of functions by transforming the basic function $y=x$ to create linear models for data. Linear regression and analyzing residuals is explored when finding the line of best fit for a data set.</p>	<p>8-SP.1: Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.</p> <p>8-SP.2: Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.</p> <p>8.SP.3: Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.</p> <p>N-Q.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.</p> <p>N-Q.2: Define appropriate quantities for the purpose of descriptive modeling.</p> <p>N-Q.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>F-IF.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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</i></p> <p>F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*</p> <p>F-IF.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.*</p> <p>F-IF.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>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 positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.</p> <p>F-LE.1b: Recognize situations in which one quantity changes at a constant rate per unit interval relative to</p>

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			<p>another.</p> <p>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).</p> <p>S-ID.6a: Fit a function to data; use functions fitted to data to solve problems in the context of the data. <i>Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.</i></p> <p>S-ID.6b: Informally assess the fit of a function by plotting and analyzing residuals.</p> <p>S-ID.6c: Fit a linear function for a scatter plot that suggests a linear association.</p> <p>S-ID.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.</p> <p>S-ID.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.</p> <p>S-ID.9: Distinguish between correlation and causation.</p>
Unit 5: Linear equations and inequalities			
13: Solving linear equations	8 lessons	In this topic, students learn how equations are related to functions. The topic explores how different representations of a function lead to techniques to solve linear equations, including tables, graphs, concrete models, algebraic operations, and "undoing" (reasoning backwards).	<p>6-EE.5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.</p> <p>6-EE.9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, though of as the dependent variable, in terms of the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. <i>For example, in a problem involving motion at a constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i></p> <p>7-EE.4a: Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.</p> <p>8-EE.7a: Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).</p> <p>8-EE.7b: Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</p> <p>A-CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</p> <p>A-CED.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.</p> <p>A-CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R.</p> <p>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.</p> <p>A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>A-REI.11: Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g$</p>

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			(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.
14: Problem solving with slope triangles	3 lessons	<p>Students apply what they know about linear functions and equations in order to solve a challenging problem, while continuing to reinforce effective communication skills</p> <p>Focus Skill work:</p> <p>Working with slope, with an emphasis on slope triangles and the geometric connection to slope.</p>	<p>8-EE.7b: Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</p> <p>A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>F-IF.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.*</p> <p>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).</p>
15: Solving linear inequalities	8 lessons	<p>This topic introduces students to solution techniques for linear inequalities. Students learn to solve with graphs, tables, and algebraic operations.</p>	<p>6-EE.5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.</p> <p>6-EE.8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams.</p> <p>7-EE.4b: Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem.</p> <p>A-CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</p> <p>A-CED.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.</p> <p>A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>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 corresponding half planes.</p>

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Unit 6: Systems of linear equations and inequalities			
16: Formulating and solving systems	9 lessons	<p>This topic builds on students' understanding of solving linear equations and inequalities while introducing the concept of a system of equations and inequalities as connected to finding the values of two different variables in a situation. Students further develop their skill at representing situations, now using two variables and systems of equations and inequalities, engage in activities that help them understand the meaning of a solution to a system across multiple representations, and learn to solve systems using logical thinking, tables, and graphs. These activities help surface underlying mathematical ideas, introduce vocabulary, and develop a conceptual foundation to prepare students for success with the more general symbolic methods introduced in Topic 18.</p>	<p>8-EE.8a: Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.</p> <p>8-EE.8b: Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.</p> <p>8-EE.8c: Solve real-world and mathematical problems leading to two linear equations in two variables.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A-CED.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.</p> <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.</p> <p>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 corresponding half-planes.</p>
17: Building fluency with equation solving	3 lessons	<p>Students continue to develop their problem solving and algebraic thinking capabilities by working on a non-routine problem, The Speeding Car Problem.</p> <p>Focus Skill Work: Solving multi-step equations.</p>	<p>6.RP.3b: Solve unit rate problems including those involving unit pricing and constant speed. <i>For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?</i></p> <p>8-EE.8c: Solve real-world and mathematical problems leading to two linear equations in two variables.</p> <p>A-CED.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.</p> <p>A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <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.</p>
18: Other methods for solving systems	8 lessons	<p>Continuing with the exploration of systems of two linear equations, this topic introduces two additional algebraic methods for solving systems: the substitution method and the linear combination method. Students begin to see when to use each method, and how to interpret the results each method yields.</p>	<p>8-EE.8a: Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.</p> <p>8-EE.8b: Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.</p> <p>8-EE.8c: Solve real-world and mathematical problems leading to two linear equations in two variables.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A-CED.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.</p>

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			<p>context.</p> <p>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.</p> <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.</p>
Unit 7: Exponential relationships			
19: Exponents and exponential models	6-7 lessons*	<p>Students review the meaning of exponents and use patterns to build their understanding of zero, negative and unit-fractional exponents. They use their prior understanding of multiplication to work from examples to develop the laws of exponents, then apply these laws to solve problems and to simplify numerical and variable expressions.</p> <p>Students also build connections between their work with exponents and exponential functions. They formalize their understanding of exponential functions by working across multiple representations to identify functions as linear or exponential.</p>	<p>6-EE.1: Write and evaluate numerical expressions involving whole-number exponents.</p> <p>8-EE.1: Know and apply the properties of integer exponents to generate equivalent numerical expressions.</p> <p>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.</p> <p>N-RN.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents.</p> <p>F-BF.1a: Determine an explicit expression, a recursive process, or steps for calculation from a context.</p> <p>F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>F-IF.7e: Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.</p> <p>F-IF.8b: 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.</p> <p>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.</p> <p>F-LE.1a: Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.</p> <p>F-LE.1c: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.</p>
20: Reasoning with quantities	3 lessons	<p>Students present solutions to a non-routine problem exemplifying an exponential pattern. Students also apply exponents in the context of scientific notation, with positive exponents for large numbers and negative exponents for small numbers. Students learn how and why to express very large and very small numbers in scientific notation, building on their understanding of our</p>	<p>8-EE.1: Know and apply the properties of integer exponents to generate equivalent numerical expressions.</p> <p>8-EE.3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.</p> <p>8-EE.4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters</p>

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		positional system based on base. Focus Skill Work: Working with scientific notation.	per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
21: Problem solving with exponential functions	6 lessons	Students apply their understanding of functions and exponents to understand the behavior of exponential functions, including their connection with repeated multiplication and their different behavior in cases of growth and decay. Students connect sequences to the concept of a function. They practice distinguishing functions represented in a table, graph, rule or statement as linear or exponential and connect sequences to the concept of a function. Students also explore the effects of changing the a and b parameters in a function of the form $y = ab^x$.	<p>F-BF.1a: Determine an explicit expression, a recursive process, or steps for calculation from a context.</p> <p>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 positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.</p> <p>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 $n \geq 1$.</p> <p>F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>F-IF.05: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*</p> <p>F-IF.7e: Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.</p> <p>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.</p> <p>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).</p> <p>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.</p> <p>F-LE.5: Interpret the parameters in a linear or exponential function in terms of a context.</p> <p>A-SSE.3c: Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} = 1.01212^t$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p>

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Unit 8: Quadratic functions and equations		
22: Quadratic models and equations	10 lessons	<p>This topic introduces students to quadratic equations that arise from quadratic functions. Students learn how to use functions of the form $y = ax^2 + c$ to model quadratic relationships. They also explore the effects of parameter changes, including vertical and horizontal shifts and dilations. Students make connections among the x-intercepts of a graph, the zeros of a function, and the solutions of an equation as they learn to solve quadratic equations by graphing. Students are also introduced to the quadratic formula as a second method for solving quadratic equations. Since using this formula sometimes requires students to simplify expressions containing square roots, the connection between the algebra and the geometry of square roots is explored. Students also learn how the value of the discriminant indicates the nature of the solutions.</p>
		<p>8-NS.1: Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion, which repeats eventually into a rational number.</p> <p>8-EE.2: Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.</p> <p>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.</p> <p>A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A-REI.4b: 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.</p> <p>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 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.</p> <p>F-BF.1a: Determine an explicit expression, a recursive process, or steps for calculation from a context.</p> <p>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 positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.</p> <p>F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*</p> <p>F-IF.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.</p>

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23: Polynomial addition and multiplication	5 lessons	In this topic students explore polynomial operations in a situation involving the floor plan of a house. They learn how to multiply, add, and subtract polynomials using concrete models and analytic techniques.	<p>A-SSE.1a: Interpret parts of an expression, such as terms, factors, and coefficients.</p> <p>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.</p>
24: Factoring and quadratic equations	9 lessons	This topic builds on the work of the previous topic by introducing students to the concept of factoring a polynomial expression. Students develop an understanding of the factoring process by making connections between concrete models and analytic techniques. Students also use concrete models to solve an equation by completing the square and connect the concrete model to the algebraic technique. Students then apply the methods of factoring and completing the square to solve quadratic equations and further solidify their understanding of the connections among the solutions of an equation, the x-intercepts of a graph, and the zeros of a function. Completing the square is also used to reveal certain characteristics about quadratic functions.	<p>A-SSE.2: Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.</p> <p>A-SSE.3a: Factor a quadratic expression to reveal the zeros of the function it defines.</p> <p>A-SSE.3b: Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</p> <p>A-APR.3: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.</p> <p>A-REI.4a: 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.</p> <p>A-REI.4b 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 $a ± bi$ for real numbers a and b.</p> <p>F-IF.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>F-IF.8a: Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of the context.</p>
Appendix			
Descriptive statistics	7 45-minute blocks	In this topic, students build on their understanding of numerical and graphical representations of univariate data. They also explore how to summarize and analyze bivariate categorical data.	<p>S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>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.</p> <p>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).</p> <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.</p>