

Merrimack School District
Mathematics Curriculum

Algebra One

Standards for Mathematical Practices

The College and Career Readiness State Standards for Mathematical Practice are expected to be integrated into every mathematics lesson for all students Grades K-12. Below are a few examples of how these Practices may be integrated into tasks that students complete.

Mathematic Practices	Explanations and Examples
1. Make sense of problems and persevere in solving them.	Mathematically proficient students should solve problems by applying their understanding of operations with whole numbers, decimals, and fractions including mixed numbers. They solve problems related to volume and measurement conversions. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, “What is the most efficient way to solve the problem?”, “Does this make sense?”, and “Can I solve the problem in a different way?”.
2. Reason abstractly and quantitatively.	Mathematically proficient students should recognize that a number represents a specific quantity. They connect quantities to written symbols and create a logical representation of the problem at hand, considering both the appropriate units involved and the meaning of quantities. They extend this understanding from whole numbers to their work with fractions and decimals. Students write simple expressions that record calculations with numbers and represent or round numbers using place value concepts.
3. Construct viable arguments and critique the reasoning of others.	Mathematical proficient students may construct arguments using concrete referents, such as objects, pictures, and drawings. They explain calculations based upon models and properties of operations and rules that generate patterns. They demonstrate and explain the relationship between volume and multiplication. They refine their mathematical communication skills as they participate in mathematical discussions involving questions like “How did you get that?” and “Why is that true?” They explain their thinking to others and respond to others’ thinking.
4. Model with mathematics.	Mathematically proficient students experiment with representing problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, making a chart, list, or graph, creating equations, etc. Students need opportunities to connect the different representations and explain the connections. They should be able to use all of these representations as needed. Students should evaluate their results in the context of the situation and whether the results make sense. They also evaluate the utility of models to determine which models are most useful and efficient to solve problems.

Mathematic Practices	Explanations and Examples
5. Use appropriate tools strategically.	Mathematically proficient students consider the available tools (including estimation) when solving a mathematical problem and decide when certain tools might be helpful. For instance, they may use unit cubes to fill a rectangular prism and then use a ruler to measure the dimensions. They use graph paper to accurately create graphs and solve problems or make predictions from real world data.
6. Attend to precision.	Mathematically proficient students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to expressions, fractions, geometric figures, and coordinate grids. They are careful about specifying units of measure and state the meaning of the symbols they choose. For instance, when figuring out the volume of a rectangular prism they record their answers in cubic units.
7. Look for and make use of structure.	Mathematically proficient students look closely to discover a pattern or structure. For instance, students use properties of operations as strategies to add, subtract, multiply and divide with whole numbers, fractions, and decimals. They examine numerical patterns and relate them to a rule or a graphical representation.
8. Look for and express regularity in repeated reasoning.	Mathematically proficient students use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and their prior work with operations to understand algorithms to fluently multiply multi-digit numbers and perform all operations with decimals to hundredths. Students explore operations with fractions with visual models and begin to formulate generalizations.

Number and Quantity: The Real Number System		N-RN
College and Career Readiness Cluster		
Extend the properties of exponents		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: expression, radicand, radical, exponent, base, perfect square, power.		
Enduring Understandings: Operations involving exponents follow the rules of operations which conform to our prior learning.		
Essential Questions: How can I use exponent properties to rewrite expressions?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
N.RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Simplify $\sqrt{8x^3}$ Example: Simplify $\sqrt{32}$

Number and Quantity: Quantities		N.Q
College and Career Readiness Cluster		
Reason quantitatively and use units to solve problems.		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: scale		
Enduring Understandings: Examining the units supplied in a problem and the expected units of its answer can help the problem solving process.		
Essential Questions: What can the units given in a problem tell me about how to solve it?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas ; choose and	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.	<p>Example: Given the speed in <i>mph</i> and time traveled in <i>hours</i>, what is the distance traveled?</p> <p>From looking at the units, we can determine that we must multiply <i>mph</i> times <i>hours</i> to get an answer expressed in miles: $\left(\frac{mi}{hr}\right)(hr) = mi$</p> <p>Example: The length of a spring increases 2 cm for every 4 oz. of weight attached. Determine how much the spring will increase if 10 oz. are attached: $\left(\frac{2cm}{4oz}\right)(10oz) = 5cm$.</p> <p>This can be extended into a multi-step problem when asked for the length of a 6 cm spring after 10 oz. are attached: $\left(\frac{2cm}{4oz}\right)(10oz) + 6cm = 11cm$.</p>

<p>interpret the scale and the origin in graphs and data displays.</p>	<p>MP.8 Look for and express regularity in repeated reasoning.</p>	<p>Example: If $density = \frac{mass\ in\ grams}{volume\ in\ mL}$ then the unit for density is $\frac{grams}{mL}$.</p>
<p>N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p>	<p>MP.1 Make sense of problems and persevere in solving them.</p> <p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>	<p>Example: Explain how the units cm, cm², and cm³ are related and how they are different.</p> <p>Describe situations where each would be an appropriate unit of measure.</p>
<p>N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>	<p>MP.4 Model with mathematics.</p> <p>MP.6 Attend to precision.</p>	<p>Example: Students should recognize that 6.15 turtles is not a reasonable solution.</p>

Number and Quantity: The Complex Number System		N-CN
College and Career Readiness Cluster		
Use complex numbers in polynomial equations		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: imaginary, complex, discriminant, solution.		
Enduring Understandings: Solutions to quadratic equations are not limited to the real number system.		
Essential Questions: When should I expect one, two, or no real solutions to a quadratic equation? How do we demonstrate and explain the solution(s) for a quadratic equation?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
N.CN.C.7 Solve quadratic equations with real coefficients that have complex solutions.	MP.2 Reason abstractly and quantitatively. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Determine when a quadratic equation in standard form, $ax^2 + bx + c = 0$, has complex roots by looking at a graph of $f(x) = ax^2 + bx + c$ or by calculating the discriminant. Example: Use the quadratic formula to write quadratic equations with the following solutions. <ol style="list-style-type: none"> One real number solution Solutions that are complex numbers. Two real number solutions

Algebra: Seeing Structure in Expressions		A-SSE
College and Career Readiness Cluster		
Interpret the structure of expressions		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: equation, factor, coefficient, constant, term, like terms, exponent, solution, simplify, expression, algebraic expression, variable, simplify, evaluate, factor.		
Enduring Understandings: Mathematical expressions contain recognizable structures which can be used to understand them.		
Essential Questions: How can expressions be rewritten in order to make better use of them? (Explain)		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
A.SSE.A.1 Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients.	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments and	Example: <ul style="list-style-type: none"> • Explain the difference between an expression and an equation • Use appropriate vocabulary for the parts that make up the whole expression • Identify the different parts of the expression and explain their meaning within the context of a problem • Decompose expressions and make sense of the multiple factors and terms by explaining the meaning of the individual parts Example: A student recognizes that in the expression $2x + 1$, “2” is the coefficient, “2” and “x” are factors, and “1” is a constant, as well as “2x” and “1” being terms of the binomial expression. Also, a student recognizes that in the expression $4(3)^x$, 4 is the coefficient, 3 is the factor, and x is the exponent.

<p>b. 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>	<p>critique the reasoning of others.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>MP.7 Look for and make use of structure.</p>	<p>Example: The height (<i>in feet</i>) of a balloon filled with helium can be expressed by $5 + 6.3s$ where s is the number of seconds since the balloon was released. Identify and interpret the terms and coefficients of the expression.</p> <p>Example: A company uses two different sized trucks to deliver sand. The first truck can transport x cubic yards, and the second y cubic yards. The first truck makes S trips to a job site, while the second makes T trips. What do the following expressions represent in practical terms?</p> <p>a. $S + T$ b. $x + y$ c. $xS + yT$ d. $\frac{xS + yT}{S + T}$</p>
<p>A.SSE.A.2 Use the structure of an expression to identify ways to rewrite it.</p>	<p>MP.7 Look for and make use of structure.</p> <p>MP.8 Look for and express regularity in repeated reasoning.</p>	<p>Example: Rewrite the expression $2(x - 1)^2 - 4$ into an equivalent quadratic expression of the form $ax^2 + bx + c$.</p> <p>Example: Rewrite the following expressions as the product of at least two factors and as the sum or difference of at least two totals.</p> <p>a. $x^2 - 25$ b. $5x^2 - 15x + 10$ c. $3x + 6x$</p>

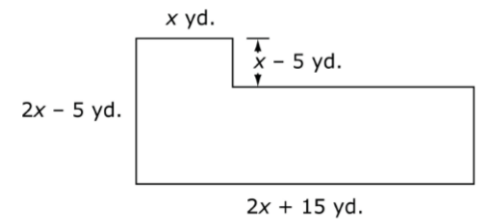
Algebra: Seeing Structure in Expressions		A-SSE
College and Career Readiness Cluster		
Write Expressions in Equivalent Forms to Solve Problems		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: factor, equivalent expressions, and zeros.		
Enduring Understandings: Expressions can be written or rewritten in equivalent forms to solve problems.		
Essential Questions: How can I formulate or reformulate an expression to simplify a situation? How can I formulate or reformulate an equation in order to obtain a solution easier?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
A.SSE.B.3 a. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.	Example: The expression $-4x^2 + 8x + 12$ represents the height of a coconut thrown from a person in a tree to a basket on the ground where x is the number of seconds. <ol style="list-style-type: none"> Rewrite the expression to reveal the linear factors. Identify the zeroes and intercepts of the expression and interpret what they mean in regards to the context. How long is the ball in the air?

<p>A.SSE.B.3 b. Factor a quadratic expression to reveal the zeros of the function it defines.</p>	<p>MP.5 Use appropriate tools strategically. MP.7 Look for and make use of structure.</p>	
<p>A.SSE.B.3 c. Use the properties of exponents to transform expressions for exponential functions.</p>	<p>MP.1 Make sense of problems and persevere in solving them. MP.4 Model with mathematics. MP.7 Look for and make use of structure.</p>	<p>Example: A recent college grad signed up for a new credit card with a promotional annual interest rate of 7.5% for the first year. With an initial debt of \$39394.32 how much interest has been charged after x months?</p> <p>Example: A family who lives on Baboosic Lake is considering the purchase of a jet ski. With some research, the family discovered that a used jet ski depreciates at 8% per year. The family wants to predict the resale value of the jet ski 20 months after purchasing it for \$3500?</p>

Algebra: Arithmetic with Polynomials and Rational Expressions		A-APR
College and Career Readiness Cluster		
Perform Operations on Polynomials		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: terms, like terms, coefficient.		
Enduring Understandings: Polynomials produce polynomials when added, subtracted, and/or multiplied. Essential Questions: How do we add, subtract and/or multiply polynomials?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
A.APR.A.1 Understand that polynomials form a system analogous to the integers; namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract,	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Write at least two equivalent expressions for the area of the circle with a radius of $5x - 2$ kilometers. Example: Simplify each of the following: a. $(4x + 3) - (2x + 1)$ b. $(x^2 + 5x - 9) + 2x(4x - 3)$ Example: A town council plans to build a public parking lot. This outline represents the proposed shape of the parking lot. a. Write an expression for the area, in square feet, of this proposed parking lot. Explain the reasoning you used to find the expression.

and multiply
polynomials.

- b. The town council has plans to double the area of the parking lot in a few years. They plan to increase the length of the base of the parking lot by p yards, as shown in the diagram below.



Write an expression in terms of x to represent the value of p , in feet. Explain the reasoning you used to find the value of p .

Algebra: Creating Equations		A-CED
College and Career Readiness Cluster		
Create Equations that Describe Numbers or Relationships.		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language.		
Enduring Understandings: Equations/inequalities are used to model relationships.		
Essential Questions: How do we create an equation/inequality to model a given situation? How do we solve the equation/inequality that models a situation?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational</i>	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments and critique the reasoning of others.	Example: The Tindell household contains three people of different generations. The total of the ages of the three family members is 85. <ol style="list-style-type: none"> Find reasonable ages for the three Tindells. Find another reasonable set of ages for them. In solving this problem, one student wrote $C + (C + 20) + (C + 56) = 85$ <ol style="list-style-type: none"> What does C represent in this equation? What do you think the student had in mind when using the numbers 20 and 56? What set of ages did the student come up with? Example: Mary and Jeff both have jobs at a baseball park selling bags of peanuts. They get paid \$12 per game and \$1.75 for each bag of peanuts they sell. Create equations, that when solved, would answer the following questions: <ol style="list-style-type: none"> How many bags of peanuts does Jeff need to sell to earn \$54? How much will Mary earn if she sells 70 bags of peanuts at a game? How many bags of peanuts does Jeff need to sell to earn at least \$68?

<p><i>and exponential functions.</i></p>	<p>MP.4 Model with mathematics.</p> <p>MP.7 Look for and make use of structure.</p> <p>MP.8 Look for and express regularity in repeated reasoning.</p>	<p><u>Example:</u> Phil purchases a used truck for \$11,500. The value of the truck is expected to decrease by 20% each year. When will the truck first be worth less than \$1,000?</p> <p><u>Example:</u> A scientist has 100 grams of a radioactive substance. Half of it decays every hour. How long until 25 grams remain? Write and solve an equation to represent this situation.</p> <p><u>Example:</u> The function $h(x) = 0.04x^2 - 3.5x + 100$ defines the height (in feet) of a major support cable on a suspension bridge from the bridge surface where x is the horizontal distance (in feet) from the left end of the bridge.</p> <ol style="list-style-type: none"> Where is the cable less than 40 feet above the bridge surface? Where is the cable at least 60 feet above the bridge surface?
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<p>A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p>	<p>MP.1 Make sense of problems and persevere in solving them.</p> <p>MP.4 Model with mathematics.</p> <p>MP.6 Attend to precision.</p>	<p>Example: The FFA had a fundraiser selling hot dogs for \$1.50 and drinks for \$2.00. Their total sales were \$400.</p> <ol style="list-style-type: none"> Write an equation to calculate the total of \$400 based on the hot dog and drink sales. Graph the relationship between hot dog sales and drink sales. <p>Example: A spring with an initial length of 25 cm will compress 0.5 cm for each pound applied.</p> <ol style="list-style-type: none"> Write an equation to model the relationship between the amount of weight applied and the length of the spring. Graph the relationship between pounds and length. What does the graph reveal about limitation on weight? <p>Example: The cheerleaders are launching t-shirts into the stands at a football game. They are launching the shirts from a height of 3 feet off the ground at an initial velocity of 36 feet per second. What function rule shows a t-shirt's height h related to the time t? (Use $16t^2$ for the effect of gravity on the height of the t-shirt.)</p> <p>Example: The local park is designing a new rectangular sandlot. The sandlot is to be twice as long as the original square sandlot and 3 feet less than its current width. What must be true of the original square lot to justify that the new rectangular lot has more area?</p> <p>Example: In a women's professional tennis tournament, the money a player wins depends on her finishing place in the standings. The first-place finisher wins half of \$1,500,000 in total prize money. The second-place finisher wins half of what is left; then the third-place finisher wins half of that, and so on.</p> <ol style="list-style-type: none"> Write a rule to calculate the actual prize money in dollars won by the player finishing in nth place, for any positive integer n. Graph the relationship between the first 10 finishers and the prize money in dollars. What pattern is indicated in the graph? What type of relationship exists between the two variables?
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<p>A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. <i>For example, rearrange Ohm's law $V = IR$ to highlight resistance R.</i></p>	<p>MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically. MP.7 Look for and make use of structure.</p>	<p>Example: Write $2x - 3y = 5$ in slope-intercept form. Explicitly connect this to the process of solving equations using inverse operations.</p>
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Algebra: Reasoning with Equations and Inequalities		A-REI
College and Career Readiness Cluster		
Understand Solving Equations as a Process of Reasoning and Explain the Reasoning		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: inverse operations		
Enduring Understandings: Justification of each step in the solution of an equation Inverse operations are the key to justifying and solving equations.		
Essential Questions: How are inverse operations used to find the solution to an equation? How does justifying each step of the solution ensure accuracy?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
A.REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution . Construct a viable argument to justify a solution method.	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments and critique the reasoning of others.	Example: Assuming $5(x + 3) - 3x = 55$ has a solution; construct a convincing argument that justifies each step in the solution process. Justifications may include the associative, commutative, and division and identity properties, combining like terms, etc.

<p>A.REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.</p>		<p><u>Example:</u> Solve $y = \frac{70}{x}$, when $y = 5$.</p> <p><u>Example:</u> Solve $\sqrt{x} - 1 = x - 7$.</p> <p><u>Example:</u> Solve $5 - \sqrt{-(x - 4)} = 2$ for x.</p> <p><u>Example:</u> Mary solved $x = \sqrt{2 - x}$ for x and got $x = -2$ and $x = 1$. Evaluate her solutions and determine if she is correct, and explain your reasoning. How did she get an extraneous solution?</p>
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Algebra: Reasoning with Equations and Inequalities		A-REI
College and Career Readiness Cluster		
Solve Equations and Inequalities in One Variable		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: inverse operations .		
Enduring Understandings: Inverse operations are the key to solving equations or inequalities.		
Essential Questions: How are inverse operations used to find the solution to an equation or inequalities?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
A.REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	MP.1 Make sense of problems and persevere in solving them. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Solve: <ul style="list-style-type: none"> $\frac{7}{3}y - 8 = 111$ $3x > 9$ Solve $ax + 7 = 12$ for x. $\frac{3+x}{7} = \frac{x-9}{4}$ $\frac{2}{3}x + 9 < 18$ Example: Solve $(y - y_1) = m(x - x_1)$ for m .

<p>A.REI.B.4 b. Solve quadratic equations in one variable. 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>MP.1 Make sense of problems and persevere in solving them.</p> <p>MP.6 Attend to precision.</p> <p>MP.7 Look for and make use of structure.</p>	<p>Examples:</p> <ul style="list-style-type: none"> a. Square root $3x^2 + 9 = 72$ b. Quadratic formula $4x^2 + 13x - 7 = 0$ c. Factoring $6x^2 + 13x = 5$ d. Graphing $4 = 2(x - 5)^2$ <p>Example: Ryan used the quadratic formula to solve an equation and his result was $x = \frac{8 \pm \sqrt{(-8)^2 - 4(1)(-2)}}{2(1)}.$</p> <ul style="list-style-type: none"> a. Write the quadratic equation Ryan started with. b. Simplify the expression to find the solutions. c. What are the x-intercepts of the graph of the corresponding quadratic function? <p>Example: Solve $x^2 + 8x = -17$ for x.</p>
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Algebra: Reasoning with Equations and Inequalities		A-REI
College and Career Readiness Cluster		
Solve Systems of Equations		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: system of equations, inconsistent system.		
Enduring Understandings: Solutions to systems of equations are the shared solutions to all equations in the system.		
Essential Questions: How can we find the common solutions to more than one equation?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
A.REI.C.5 Prove that, given a system of two equations in two variables , replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.	MP.1 Make sense of problems and persevere in solving them. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.	Example: Using the system $\begin{cases} 2x + y = 13 \\ x + y = 10 \end{cases}$ <ol style="list-style-type: none"> Graph the original system of linear equations. Describe the solution of the system and how it relates to the solutions of each individual equation. Add the two linear equations together and graph the resulting equation. Describe the solutions to the new equation and how they relate to the system's solution. Explore what happens with other combinations such as: <ol style="list-style-type: none"> Multiply the first equation by 2 and add to the second equation Multiply the second equation by -2 and add to the first equation Multiply the second equation by -1 and add to the first equation Multiply the first equation by -1 and add to the second equation

		<p>d. Make a conjecture about the solution to a system and any combination of the equations.</p> <p>Example: Given that the sum of two numbers is 10 and their difference is 4, what are the numbers? Explain how your answer can be deduced from the fact that the two numbers, x and y, satisfy the equations $x + y = 10$ and $x - y = 4$.</p>
<p>A.REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.</p>	<p>MP.1 Make sense of problems and persevere in solving them.</p> <p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.6 Attend to precision.</p> <p>MP.7 Look for and make use of structure.</p>	<p>Example: José had 4 times as many trading cards as Philippe. After José gave away 50 cards to his little brother and Philippe gave 5 cards to his friend for her birthday, they each had an equal amount of cards. Write a system to describe the situation and solve the system.</p> <p>Example: A restaurant serves a vegetarian and a chicken lunch special each day. Each vegetarian special is the same price. Each chicken special is the same price. However, the price of the vegetarian special is different from the price of the chicken special.</p> <p>Thursday: Collected \$467 selling 21 vegetarian specials and 40 chicken specials.</p> <p>Friday: Collected \$484 selling 28 vegetarian specials and 36 chicken specials.</p> <p>What is the cost of each lunch special?</p> <p>Example: Solve the system of equations: $x + y = 11$ and $3x - y = 5$. Use a second method to check your answer.</p>

Algebra: Reasoning with Equations and Inequalities		A-REI
College and Career Readiness Cluster		
Represent and Solve Equations and Inequalities Graphically		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: intercept, slope, ordered pair.		
Enduring Understandings: The solutions to systems of equations or inequalities can be determined graphically.		
Essential Questions: How can we determine the solution(s) to systems of linear equations or inequalities graphically? How can a graph of a linear system indicate the number of solutions?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
A.REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.7 Look for and make use of structure.	Example: Which of the following points are on the graph of the equation $-5x + 2y = 20$? How many points are on this graph? Explain. <ul style="list-style-type: none"> a. (4, 0) b. (0, 10) c. (-1, 7.5) d. (2.3, 5) Example: Verify that $(-1, 60)$ is a solution to the equation $y = 15\left(\frac{1}{4}\right)^x$. Explain what this means for the graph of the function.

<p>A.REI.D.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.</p>	<p>MP.1 Make sense of problems and persevere in solving them.</p> <p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.3 Construct viable arguments and critique the reasoning of others.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>MP.6 Attend to precision.</p> <p>MP.8 Look for and express regularity in repeated reasoning.</p>	<p>In Algebra 1, we do not teach logarithmic or absolute value functions.</p> <p>Example: The functions $f(m) = 18 + 0.4m$ and $g(m) = 11.2 + 0.54m$ give the lengths of two different springs in centimeters, as mass is added in grams, m, to each separately.</p> <ol style="list-style-type: none"> Graph each equation on the same set of axes. What mass makes the springs the same length? What is the length at that mass? Write a sentence comparing the two springs.
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<p>A.REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.</p>	<p>MP.1 Make sense of problems and persevere in solving them.</p> <p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>MP.6 Attend to precision.</p> <p>MP.7 Look for and make use of structure.</p>	<p>Example: Graph the following inequalities:</p> $\begin{aligned} 3x - 4y &\leq 7 \\ y &> -2x + 6 \\ -9x + 4y &\geq 1 \end{aligned}$ <p>Example: Compare the solution to a system of equations to the solutions of a system of inequalities.</p> <p>Example: Describe the solution set of a system of inequalities.</p> <p>Example: Graph the solution set for the following system of inequalities:</p> $\begin{aligned} 3x + 5y &\leq 10 \\ y &> -4 \end{aligned}$ <p>Example: Graph the system of linear inequalities below and determine if (3, 2) is a solution to the system.</p> $\begin{aligned} x - 3y &> 0 \\ x + y &\leq 2 \\ x + 3y &> -3 \end{aligned}$
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Functions: Interpreting Functions		F-IF																								
College and Career Readiness Cluster																										
Understand the Concept of a Function and Use Function Notation																										
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: domain, range, function, relation, function notation.																										
Enduring Understandings: Functions are a special type of relation in which each member of the domain is mapped to exactly one member of the range.																										
Essential Questions: When is a relation not a function? How do you determine and describe the domain and range of a given function?																										
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>																								
F.IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Determine if the following tables represent a function and explain why or why not. <div><table><tr><th colspan="2">Table A</th></tr><tr><td>x</td><td>y</td></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>2</td></tr><tr><td>2</td><td>2</td></tr><tr><td>3</td><td>4</td></tr></table><table><tr><th colspan="2">Table B</th></tr><tr><td>r</td><td>T</td></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>2</td></tr><tr><td>1</td><td>3</td></tr><tr><td>4</td><td>5</td></tr></table></div>	Table A		x	y	0	1	1	2	2	2	3	4	Table B		r	T	0	0	1	2	1	3	4	5
Table A																										
x	y																									
0	1																									
1	2																									
2	2																									
3	4																									
Table B																										
r	T																									
0	0																									
1	2																									
1	3																									
4	5																									

<p>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>Example: A pack of pencils cost \$1.75. If n number of packs are purchased, then the total purchase price is represented by the function $t(n) = 1.75n$.</p> <ol style="list-style-type: none"> Explain why t is a function. What is a reasonable domain and range for the function t?
<p>F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.</p>	<p>MP.4 Model with mathematics.</p> <p>MP.6 Attend to precision.</p>	<p>Example: Evaluate $f(2)$ for the function $f(x) = 5(x - 3) + 17$.</p> <p>Example: Evaluate $f(2)$ for the function $f(x) = 1200(1 + .04)^x$</p> <p>You placed a ham in the oven and, after 45 minutes, you take it out. Let f be the function that assigns to each minute after you placed the yam in the oven, its temperature in degrees Fahrenheit. Write a sentence for each of the following to explain what it means in everyday language.</p> <ol style="list-style-type: none"> $f(0) = 65$ $f(5) < f(10)$ $f(40) = f(45)$ $f(45) > f(60)$ <p>Example: The rule $f(x) = 50(0.85)^x$ represents the amount of a drug in milligrams, $f(x)$, which remains in the bloodstream after x hours. Evaluate and interpret each of the following:</p> <ol style="list-style-type: none"> $f(0)$ $f(2) = kf(1)$. What is the value of k?

<p>F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end</p>	<p>MP.4 Model with mathematics.</p> <p>MP.6 Attend to precision.</p> <p>MP.7 Look for and make use of structure.</p>	<p>When given a table or graph of a function that models a real-life situation, explain the meaning of the characteristics of the table or graph in the context of the problem.</p> <p><u>Example:</u> The local newspaper charges for advertisements in their community section. A customer has called to ask about the charges. The newspaper gives the first 50 words for free and then charges a fee per word. Use the table at the right to describe how the newspaper charges for the ads. Include all important information.</p> <table><tr><th># of words</th><th>Cost to place ad (\$)</th></tr><tr><td>50</td><td>0</td></tr><tr><td>60</td><td>0.50</td></tr><tr><td>70</td><td>1</td></tr><tr><td>80</td><td>1.50</td></tr><tr><td>90</td><td>2</td></tr><tr><td>100</td><td>2.5</td></tr></table> <p><u>Example:</u> The graph represents the height (in feet) of a rocket as a function of the time (in seconds) since it was launched. Use the graph to answer the following:</p> <div><div><p>a. What is the practical domain for t in this context? Why?</p><p>b. What is the height of the rocket two seconds after it was launched?</p><p>c. What is the maximum value of the function and what does it mean in context?</p><p>d. When is the rocket 100 feet above the ground?</p><p>e. When is the rocket 250 feet above the ground?</p><p>f. Why are there two answers to part e but only one practical answer for part d?</p><p>g. What are the intercepts of this function? What do they mean in the context of this problem?</p><p>h. When is the rocket rising or falling?</p></div><div></div></div>	# of words	Cost to place ad (\$)	50	0	60	0.50	70	1	80	1.50	90	2	100	2.5
# of words	Cost to place ad (\$)															
50	0															
60	0.50															
70	1															
80	1.50															
90	2															
100	2.5															

behavior; and periodicity.

Example:

Jack planted a mysterious bean just outside his kitchen window. Jack kept a table (shown below) of the plant's growth. He measured the height at 8:00 am each day.

Day	0	1	2	3	4
Height (cm)	2.56	6.4	16	40	100

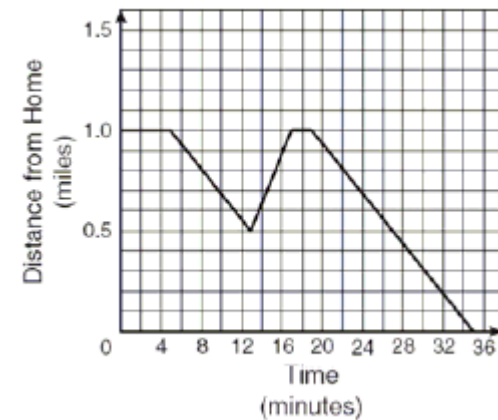
- What was the initial height of Jack's plant?
- How is the height changing each day?
- If this pattern continues, how tall should Jack's plant be after 8 days?

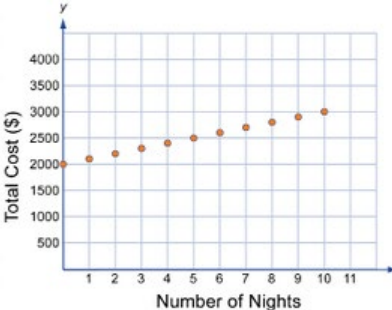
Example:

Marla was at the zoo with her mom. When they stopped to view the lions, Marla ran away from the lion exhibit, stopped, and walked slowly towards the lion exhibit until she was halfway, stood still for a minute then walked away with her mom. Sketch a graph of Marla's distance from the lions' exhibit over the period of time when she arrived until she left.

Example:

Describe a situation, in detail, that could be represented by the graph at the right.



<p>F.IF.B.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>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>	<p>Example: An all-inclusive resort in Los Cabos, Mexico provides everything for their customers during their stay including food, lodging, and transportation. Use the graph at the right to describe the domain of the total cost function.</p>  <p>Example: Jennifer purchased a cell phone and the plan she decided upon charged her \$50 for the phone and \$0.10 for each minute she is on the phone. (The wireless carrier rounds up to the half minute.) She has budgeted \$100 for her phone bill. What would be the appropriate domain for the cost as a function of the total minutes she used the phone? Describe what the point (10, 51) represents in the problem.</p> <p>Example: Maggie tosses a coin off of a bridge into a stream below. The distance the coin is above the water is modeled by the equation $y = -16x^2 + 96x + 112$, where x represents time in seconds. What is a reasonable domain for the function?</p> <p>Example: The Thomas P. Erstwhile Memorial Coliseum, home of the Westchester Ostriches, is capable of seating 63,026 fans. For each game, the amount of money that the Ostriches' organization brings in as revenue is a function of the number of people, n, in attendance. If each ticket costs \$30, find the domain of this function.</p>
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F.IF.B.6

Calculate and **interpret** the average **rate of change** of a **function** (presented symbolically or as a table) over a specified **interval**.

Estimate the rate of change from a **graph**.

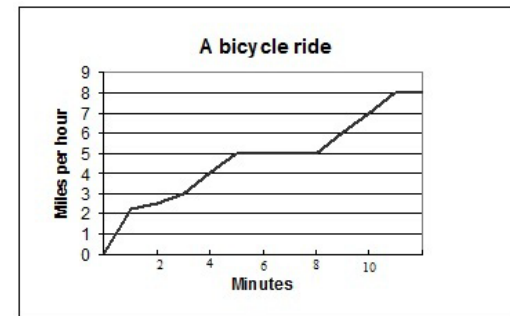
MP.7 Look for and make use of structure.

MP.4 Model with mathematics.

MP.2 Reason abstractly and quantitatively.

Example:

What is the average rate at which this bicycle rider traveled from four to ten minutes of her ride?

**Example:**

The plug is pulled from a small hot tub. The table gives the volume of water in the tub from the moment the plug is pulled, until it is empty. What is the average rate of change between:

- 60 seconds and 100 seconds?
- 0 seconds and 120 seconds?
- 70 seconds and 110 seconds?

Draining Water from a Hot Tub	
Time (s)	Volume (L)
0	1600
10	1344
20	1111
30	900
40	711
50	544
60	400
70	278
80	178
90	100
100	44
110	11
120	0

Functions: Interpreting Functions		F-IF
College and Career Readiness Cluster		
Analyze Functions Using Different Representations		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language.		
Enduring Understandings: A function's equation, graph, and table are all different representations of the same relationship.		
Essential Questions: Why do we learn different methods for representing functions? What are examples of the best uses for equation, graph, and table when representing functions?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph , by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	<u>Example:</u> Describe the key features of the graph $f(x) = \frac{-2}{3}x + 8$ and use the key features to create a sketch of the function. <u>Example:</u> Without using the graphing capabilities of a calculator, sketch the graph of $f(x) = x^2 + 7x + 10$ and identify the x -intercepts, y -intercept, and the maximum or minimum point. <u>Example:</u> The function $f(x) = 300(0.70)^x - 25$ models the amount of aspirin left in the bloodstream after x hours. Graph the function showing the key features of the graph. Interpret the key features in context of the problem.

<p>show intercepts, maxima, and minima.</p> <p>e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.</p>		
<p>F.IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.6 Attend to precision.</p> <p>MP.7 Look for and make use of structure.</p>	<p><u>Example:</u> The quadratic expression $-5x^2 + 10x + 15$ represents the height of a diver jumping into a pool off a platform. Use the process of factoring to determine key properties of the expression and interpret them in the context of the problem.</p> <p><u>Example:</u> The projected population of Merrimack is given by the function $p(t) = 1500(1.08)^{2t}$ where t is the number of years since 2010. You have been selected by the town council to help them plan for future growth. Explain to the council members what the function $p(t) = 1500(1.08)^{2t}$ means.</p>

<p>a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.</p> <p>b. Use the properties of exponents to interpret expressions for exponential functions. <i>For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y =$</i></p>		<p>Example: Suppose a single bacterium lands on one of your teeth and starts reproducing by a factor of 2 every hour. If nothing is done to stop the growth of the bacteria, write a function for the number of bacteria as a function of the number of hours.</p> <p>Example: The expression $50(0.85)^x$ represents the amount of a drug in milligrams that remains in the bloodstream after x hours.</p> <ol style="list-style-type: none"> Describe how the amount of drug in milligrams changes over time. What would the expression $50(0.85)^{12x}$ represent? What new or different information is revealed by the changed expression?
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$(0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.														
F.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.6 Attend to precision.</p> <p>MP.7 Look for and make use of structure.</p>	<p>Example: David and Fred each throw a baseball into the air. The velocity of David’s baseball is given by $v(t) = 50 - 32t$ where v is in feet per second and t is in seconds. The velocity of Fred’s baseball is given in the table. What is the difference in the initial velocity between the two throws?</p> <table><tr><td>t</td><td>$v(t)$</td></tr><tr><td>0.2</td><td>38.6</td></tr><tr><td>0.4</td><td>32.2</td></tr><tr><td>0.6</td><td>25.8</td></tr><tr><td>0.8</td><td>19.4</td></tr><tr><td>1.0</td><td>13</td></tr></table> <p>Example: Joe is trying to decide which job would allow him to earn the most money after a few years.</p> <ul style="list-style-type: none">His first job offer agrees to pay him \$50 per week. If he does a good job, they will give him a 2% raise each year.His other job offer agrees to pay him \$40 per week and if he does a good job, they will give him a 3% raise each year. <p>Which job would you suggest Joe take? Justify your reasoning.</p>	t	$v(t)$	0.2	38.6	0.4	32.2	0.6	25.8	0.8	19.4	1.0	13
t	$v(t)$													
0.2	38.6													
0.4	32.2													
0.6	25.8													
0.8	19.4													
1.0	13													

<i>function and an algebraic expression for another, say which has the larger maximum</i>	<p><u>Example:</u> Examine the two functions represented below. Compare the x-intercepts and find the difference between the minimum values.</p> <div>$f(x) = x^2 + 8x + 15$<table><tr><td>x</td><td>-7</td><td>-6</td><td>-5</td><td>-4</td><td>-3</td><td>-2</td><td>-1</td></tr><tr><td>$g(x)$</td><td>4</td><td>1.5</td><td>0</td><td>-0.5</td><td>0</td><td>1.5</td><td>4</td></tr></table></div>	x	-7	-6	-5	-4	-3	-2	-1	$g(x)$	4	1.5	0	-0.5	0	1.5	4
x	-7	-6	-5	-4	-3	-2	-1										
$g(x)$	4	1.5	0	-0.5	0	1.5	4										

Functions: Building Functions		F-BF
College and Career Readiness Cluster		
Build a Function That Models a Relationship Between Two Quantities		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: function .		
Enduring Understandings: Functions can be created and used to model real world relationships.		
Essential Questions: How can I model a physical relationship using linear, exponential, or quadratic equations?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
F.BF.A.1 Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context.	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Identify patterns in a function's rate of change. Example: Specify intervals of increase, decrease, constancy, and relate them to a function's description in words or graphically

Functions: Building Functions		F-BF
College and Career Readiness Cluster		
Build New Functions From Existing Functions		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: family of functions .		
Enduring Understandings: Sets of functions, called families, consist of transformations of a parent function.		
Essential Questions: How do changes in an equation change its graph?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
F.BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x + k)$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Describe how the graph of $f(x) + 3$ compares to the graph of $f(x)$. Example: Given the graph of $f(x)$ whose x -intercept is 3, find the value of k if $f(x + k)$ resulted in the graph having an x -intercept of -4 .

<p>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><u>Example:</u> Describe how the graph of $f(x) + k$ compares to $f(x)$ if k positive. If k is negative.</p> <p><u>Example:</u> Given the graph of $f(x) = 3^x$ and the graph of $g(x) = f(x) + k$. Find the value of k.</p>
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Functions: Linear, Quadratic, and Exponential Models		F-LE
College and Career Readiness Cluster		
Construct Linear, Quadratic, and Exponential Models and Solve Problems		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: expression, radicand, radical, exponent, base, perfect square, power.		
Enduring Understandings: Functions can be created and used to model real world relationships.		
Essential Questions: How can we write a function to model a real situation and find solutions? How can we determine the appropriate model for the given situation?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
F.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Town A adds 18 people per year to its population, and town B grows by 10% each year. In 2006, each town has 95 residents. For each town, determine whether the population growth is linear or exponential. Explain. Example: Sketch and analyze the graphs of the following two situations. What information can you conclude about the types of growth each type of interest has? Lee borrows \$9,000 from his mother to buy a car. His mom charges him 5% interest a year, but she does not compound the interest. Dee borrows \$9,000 from a bank to buy a car. The bank charges 5% interest compounded annually.

<p>differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.</p> <p>b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</p> <p>c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit</p>		<p>Example: A streaming movie service has three monthly plans to rent movies online. Graph the equation of each plan and analyze the change as the number of rentals increase. When is it beneficial to enroll in each of the plans?</p> <p>Basic Plan: \$3 per movie rental</p> <p>Watchers Plan: \$7 fee + \$2 per movie with the first two movies included with the fee.</p> <p>Home Theater Plan: \$12 fee + \$1 per movie with the first four movies included with the fee.</p> <p>Example: A couple wants to buy a house in five years. They need to save a down payment of \$8,000. They deposit \$1,000 in a bank account earning 3.25% interest, compounded quarterly. How long will they need to save in order to meet their goal?</p> <p>Example: Carbon-14 is a common form of carbon which decays exponentially over time. The half-life of Carbon-14, that is the amount of time it takes for half of any amount of Carbon-14 to decay, is approximately 5730 years. Suppose we have a plant fossil and that the plant, at the time it died, contained 10 micrograms of Carbon-14 (one microgram is equal to one millionth of a gram).</p> <ol style="list-style-type: none"> Using this information, make a table to calculate how much Carbon-14 remains in the fossilized plant after n number of half-lives. How much carbon remains in the fossilized plant after 2865 years? Explain how you know. When is there one microgram of Carbon-14 remaining in the fossil?
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interval relative to another.												
F.LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.4 Model with mathematics.	Example: Albuquerque boasts one of the longest aerial trams in the world. The tram transports people up to Sandia Peak. The table shows the elevation of the tram at various times during a particular ride. <table><tr><td>Minutes into the ride</td><td>2</td><td>5</td><td>9</td><td>14</td></tr><tr><td>Elevation in feet</td><td>7069</td><td>7834</td><td>8854</td><td>10129</td></tr></table> <ul style="list-style-type: none">a. Write an equation for a function that models the relationship between the elevation of the tram and the number of minutes into the ride.b. What was the elevation of the tram at the beginning of the ride?c. If the ride took 15 minutes, what was the elevation of the tram at the end of the ride? Example: After a winter storm, there are 10 inches of snow on the ground. Now that the sun is out, the snow is melting. At 7 am there were 10 inches and at 12 pm there were 6 inches of snow. <ul style="list-style-type: none">a. Construct a linear function rule to model the amount of snow.b. Construct an exponential function rule to model the amount of snow.c. Which model best describes the amount of snow? Provide reasoning for your choice.	Minutes into the ride	2	5	9	14	Elevation in feet	7069	7834	8854	10129
Minutes into the ride	2	5	9	14								
Elevation in feet	7069	7834	8854	10129								
F.LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a	MP.7 Look for and make use of structure.	Example: Kevin and Joseph each decide to invest \$100. Kevin decides to invest in an account that will earn \$5 every month. Joseph decided to invest in an account that will earn 3% interest every month. <ul style="list-style-type: none">a. Whose account will have more money in it after two years?b. After how many months will the accounts have the same amount of money?c. Describe what happens as the money is left in the accounts for longer periods of time.										

quantity increasing linearly, quadratically, or (more generally) as a polynomial function.		<p>Example: Compare the values of the functions when $x \geq 0$:</p> $f(x) = 2x, f(x) = 2^x, \text{ and } f(x) = x^2$								
<p>F.LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.</p>	<p>MP.4 Model with mathematics.</p>	<p>Example: A plumber's fee of \$50 for a house call and \$85 per hour can be expressed as the function $y = 85x + 50$. If the rate were raised to \$90 per hour, how would the function's equation change? How would its graph change?</p> <p>Example: Lauren keeps records of the distances she travels in a taxi and what it costs:</p> <table><tr><th>Distance d in miles</th><th>Fare f in dollars</th></tr><tr><td>3</td><td>8.25</td></tr><tr><td>5</td><td>12.75</td></tr><tr><td>11</td><td>26.25</td></tr></table> <p>a. If you graph the ordered pairs (d, f) from the table, they lie on a line. How can this be determined without graphing them?</p> <p>b. Prove that the linear function has equation $F = 2.25d + 1.5$.</p> <p>c. What do the 2.25 and the 1.5 in the equation represent in terms of taxi rides?</p>	Distance d in miles	Fare f in dollars	3	8.25	5	12.75	11	26.25
Distance d in miles	Fare f in dollars									
3	8.25									
5	12.75									
11	26.25									

Geometry: Expressing Geometric Properties With Equations		G-GPE
College and Career Readiness Cluster		
Use Coordinates to Prove Simple Geometric Theorems Algebraically.		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: slope, parallel lines, perpendicular lines, coordinates, opposite, and reciprocal.		
Enduring Understandings: Algebraic reasoning can be used to prove geometric theorems.		
Essential Questions: What is the difference between the slopes of parallel lines and the slopes of perpendicular lines? How do you determine if lines are neither parallel nor perpendicular?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>
G.GPE.B.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems.	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: Suppose a line k in a coordinate plane has slope $\frac{c}{d}$. <ol style="list-style-type: none"> What is the slope of a line parallel to k? What is the slope of a line perpendicular to k? Example: Two points $A(0, -4)$, $B(2, -1)$ determine a line, \overleftrightarrow{AB} . <ol style="list-style-type: none"> What is the equation of the line \overleftrightarrow{AB}? What is the equation of the line perpendicular to \overleftrightarrow{AB} passing through the point $(2, -1)$?

Probability and Statistics: Interpreting Categorical and Quantitative Data			S-ID
College and Career Readiness Cluster			
Summarize, Represent, and Interpret Data of a Single Count or Measurement Variable			
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: dot plots, histograms, box plots, data			
Enduring Understandings: The most appropriate visual representation is dependent on the data being modeled.			
Essential Questions: How does a particular graph improve our understanding of data?			
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>	
S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: The following data set shows the number of songs downloaded in one week by each student in Mrs. Jones class: 10, 20, 12, 14, 12, 27, 88, 2, 7, 30, 16, 16, 32, 25, 15, 4, 0, 15, 6. Choose and create a plot to represent the data.	

Probability and Statistics: Interpreting Categorical and Quantitative Data			S-ID														
College and Career Readiness Cluster																	
Summarize, Represent, and Interpret Data on Two Categorical and Quantitative Variables																	
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: scatter plot, line of best fit, linear regression, exponential regression, correlation																	
Enduring Understandings: The most appropriate function is dependent on the data being modeled.																	
Essential Questions: How do we determine the appropriate algebraic model for a set of data? Why is it important to graph data as a means of determining the appropriate algebraic model?																	
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>															
S.ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Example: In an experiment, 300 pennies were shaken in a cup and poured onto a table. Any pennies ‘heads up’ were removed. The remaining pennies were returned to the cup and the process was repeated. The results of the experiment are shown below. <table><tr><td># of rolls</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td># of pennies</td><td>300</td><td>164</td><td>100</td><td>46</td><td>20</td><td>8</td></tr></table> Write a function rule suggested by the context.		# of rolls	0	1	2	3	4	5	# of pennies	300	164	100	46	20	8
# of rolls	0	1	2	3	4	5											
# of pennies	300	164	100	46	20	8											

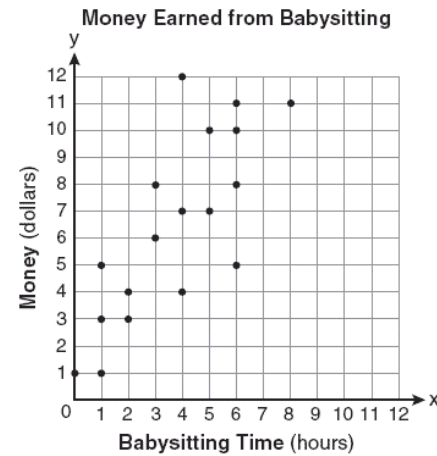
problems in the context of the data. Use given functions or **choose** a function suggested by the context. **Emphasize** linear, quadratic, and exponential models.

c. **Fit** a linear function for a scatter plot that suggests a linear association.

Example:

Which of the following equations best models the (babysitting time, money earned) data?

$$y = x \qquad y = \frac{6}{5}x + 2 \qquad y = \frac{3}{2}x + 4 \qquad y = \frac{1}{4}x + 4$$



Probability and Statistics: Interpreting Categorical and Quantitative Data		S-ID
College and Career Readiness Cluster		
Interpret Linear Models		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: slope, constant, y-intercept, rate of change, linear regression		
Enduring Understandings: Linear functions can be created and used to model real world relationships.		
Essential Questions: How can I model real situations using equations? What is the rate of change of the given linear model? How do you make predictions based on the linear model?		
College and Career Readiness Standards <i>Students are expected to:</i>	Mathematical Practices	Unpacking Explanations and Examples <i>What does this standard mean that a student will know and be able to do?</i>