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Grade 8

Sample Tasks for PreK-8, developed by New York State teachers, are clarifications, further explaining the language and intent of the associated Performance Indicators. These tasks are not test items, nor are they meant for students' use. **Note:** There are no Sample Tasks for the Statistics and Probability Strand. Although there are no Performance Indicators for this strand at this grade level, this strand is still part of instruction within the other strands as an ongoing continuum and building process of mathematical knowledge for all students.

Strands

Process	Content
Problem Solving	Number Sense and Operations
Reasoning and Proof	Algebra
Communication	Geometry
Connections	Measurement
Representation	Statistics and Probability

Problem Solving Strand

Students will build new mathematical knowledge through problem solving.

8.PS.1 Use a variety of strategies to understand new mathematical content and to develop more efficient methods

8.PS.1a
Have students draw a pair of intersecting lines and measure the four angles with a protractor to verify the congruent angles. Have students draw another pair of intersecting lines and use tracing paper to verify the congruent angles. Ask students to measure one of the angles and determine the measurements of the remaining angles.

Have students use a ruler to draw two parallel lines, intersected by a transversal. Ask students to use a protractor to measure one of the angles.

Using what they know about vertical angles and tracing paper, find the other angles. Ask the students to summarize the relationships they discovered, using mathematical vocabulary.

8.PS.2 Construct appropriate extensions to problem situations

8.PS.2a
Give the students three ordered pairs and have them graph the ordered pairs in the coordinate plane. Using a straightedge, have the students draw a line containing the three points. Then have the students name three additional

ordered pairs contained on the line. Using their ordered pairs, have students write the numerical pattern in algebraic terms.

8.PS.3 Understand and demonstrate how written symbols represent mathematical ideas

8.PS.3a
Matthew is going to drive his racecar in a 50-lap event. When he arrives at the track, his car contains 2 gallons of fuel in the tank. His car uses 1 gallon of fuel for every six laps. What is the minimum number of gallons of fuel he must purchase to finish the race? Write an inequality and solve.

Give students situations that limit their spending of money or time. Have students write the situations using algebraic wording, symbols, and inequalities.

Example 1: You must be home by 10:00PM
x is less than or equal to 10, $x \leq 10$
Example 2: The least you will get paid is thirty dollars.
x is greater than or equal to 30, $x \geq 30$

Students will solve problems that arise in mathematics and in other contexts.

8.PS.4 Observe patterns and formulate generalizations

8.PS.5 Make conjectures from generalizations

8.PS.5a
Using the coordinate plane, have students approximate the image of a given point after a rotation of 90 degrees counter clockwise about the origin. Repeat this process for several additional points. Using the given points and their images, ask students to make a conjecture about the algebraic rule that represents this transformation.

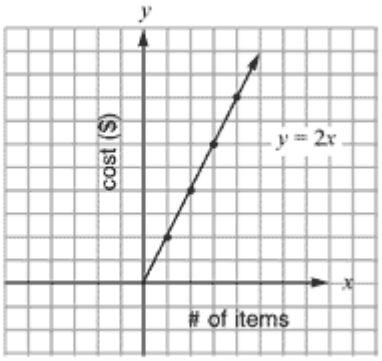
8.PS.6 Represent problem situations verbally, numerically, algebraically, and graphically

8.PS.6a
Provide the students 16 examples (4 of each) showing a situation represented verbally, numerically, algebraically, and graphically. Ask students to match each example with the other three representations.

Example:
VERBALLY: the selling price is twice the cost of the product
NUMERICALLY: selling price: $40 cost: $20
ALGEBRAICALLY: y = 2x
GRAPHICALLY:

$y = 2x$

x	y
0	0
1	2
2	4
3	6
4	8



Students will apply and adapt a variety of appropriate strategies to solve problems.

8.PS.7 Understand that there is no one right way to solve mathematical problems but that different methods have advantages and disadvantages

8.PS.7a
Have students in small groups each solve the same problem (e.g., find the sale price after a 10% discount on a $40.00 sweater). Have each group present different solutions and discuss advantages and disadvantages of each of the different methods.

8.PS.8 Understand how to break a complex problem into simpler parts or use a similar problem type to solve a problem

8.PS.8a
Have students complete an invoice for a sale of multiple items. Show students a sample of a complete invoice from a catalog. The invoice should include a discount, shipping and handling, and sales tax. Have students complete a set of step-by-step directions for the completion of the invoice to explain each of the calculations in order.

8.PS.9 Work backwards from a solution

8.PS.9a
Provide students the final cost of an item after a discount of 10% and a sales tax of 7%. Ask students to work backward to determine the original cost of the item.

8.PS.10 Use proportionality to model problems

8.PS.10a
Provide students a map and have them determine the distance between cities using the scale of the map and a ruler.

8.PS.10b
Take the students outside to estimate the height of the school's flagpole to the nearest foot. Have students measure the shadow of the flagpole, the shadow of one of the class members, as well as that class member's height in inches. Once the data are collected, ask students to write and solve a proportion to determine the approximate height of the flagpole to the nearest foot.

8.PS.11 Work in collaboration with others to solve problems

8.PS.11a
Divide the class into groups and have them work as a group to furnish an apartment. Each group member is responsible for furnishing a room within a given budget. Provide the dimensions of each room and ask the group to construct a scale drawing of each room, and plan their expenditures for the furnishings.

Students will monitor and reflect on the process of mathematical problem solving.

8.PS.12 Interpret solutions within the given constraints of a problem

8.PS.12a
Have the students play *Guess My Number*.

Example: Given the following choices and clues, guess my number.
2, 17, 18, 16, 25, 47, 49.
My number is less than 30.
My number is a perfect square.
My number is a power of 2.

8.PS.13 Set expectations and limits for possible solutions

8.PS.13a
A ball is thrown from one player to another. Each of the players is six feet tall. Using a coordinate plane, let y= height of the ball and x= elapsed time. Ask students to determine and explain if the following values are unreasonable or reasonable.

For example:

Reasonable	Explain Why
x = 2 seconds, y = 15 feet	
x = 3 seconds, y = 20 feet	
Unreasonable	
x = 1 seconds, y = 0 feet	
x = 4 seconds, y = -10 feet	

8.PS.14 Determine information required to solve the problem

8.PS.14a
Given the equations y = 2x - 3 and y = ½ x - 3 identify the information required to graph the two equations. Have students graph the two equations and note the similarities and differences.

8.PS.15 Choose methods for obtaining required information

8.PS.15a
Have students choose from a variety of methods to solve the following problem such as creating a table, setting up a proportion, or drawing a graph:

A cheetah ran 300 feet in 2.92 seconds. Calculate the cheetah's speed in miles per hour.

8.PS.16 Justify solution methods through logical argument

8.PS.16a
Have students use rulers and protractors to justify congruence of the image and preimage of figures after a reflection. Have students justify their method with logical argument.

Example: The triangles are congruent because all the angles measure 60 degrees and all the sides measure 4 cm.

8.PS.17 Evaluate the efficiency of different representations of a problem

8.PS.17a
Ask the students to determine which of the following methods would best illustrate the difference between a linear and a quadratic function:

- Compare tables of values.
- Compare graphs.
- Compare equations.
- Compare situations.

Have students explain their reasoning for the chosen method.

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Reasoning and Proof Strand

Students will recognize reasoning and proof as fundamental aspects of mathematics.

8.RP.1 Recognize that mathematical ideas can be supported by a variety of strategies

8.RP.1a
Have students match the solutions to various problems done arithmetically, algebraically, and graphically to determine which would be the most appropriate way of solving the problem.
Example: Determine if the point (8,22) is contained on the line whose equation is $y = 3x - 2$. Students may complete a table of values until the point appears, substitute this point directly into the equation, or graph the line and see that it passes through the point.

Students will make and investigate mathematical conjectures.

8.RP.2 Use mathematical strategies to reach a conclusion.

8.RP.2a
Have students use inductive reasoning to show the angle relationships when two parallel lines are cut by a transversal. Provide tracing paper and a straight edge.

8.RP.3 Evaluate conjectures by distinguishing relevant from irrelevant information to reach a conclusion or make appropriate estimates.

8.RP.3a
Four students had lunch at a restaurant. Two of the students had hamburgers and the other two had chicken salad. The total bill came to $40.55, which included $2.65 in sales tax. Jamal had a coupon for $5.00 off the total bill. The students decided to leave a 15% gratuity and agreed to contribute the same amount. Estimate to the nearest whole dollar the amount that each student should contribute to pay the bill.

8.RP.3b
Jenna went to Roosevelt Field Mall to buy her older sister a birthday present. She had $50.00 in her wallet. She went to three stores and finally found a sweatshirt for her sister. The sweatshirt was originally $42.00 but was on sale at 25% off the original price. She had to pay sales tax of 8.75%. Calculate the total cost of the sweatshirt.

Students will develop and evaluate mathematical arguments and proofs.

8.RP.4 Provide supportive arguments for conjectures

8.RP.4a
Ask students to complete a table of (x,y) values $x = -2$ to $x = 5$ for the function $y = x^2 - 3x - 10$. Ask students to make a conjecture that summarizes any patterns they see in their table of values, and provide a rationale.

8.RP.5 Develop, verify and explain an argument, using appropriate mathematical ideas and language.

8.RP.5a
Have students develop and explain the argument that the final price is the same whether the discount is taken before or after the tax, using appropriate mathematical language.

8.RP.6 Support an argument by using a systematic approach to test more than one case.

8.RP.6a
Using a graphing calculator, have students graph $y = 2x - 1$, $y = 2x + 2$, $y = 2x + 5$, and $y = 2x$. Have students make a generalization and test it by graphing additional lines.

8.RP.7 Devise ways to verify results or use counterexamples to refute incorrect statements.

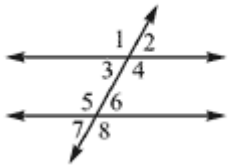
8.RP.7a
Challenge students to either support the following statement by providing multiple examples or to refute this statement by providing a counterexample in the coordinate plane.
If a triangle is reflected in the x-axis, angle measure, distance and orientation (clockwise vs. counterclockwise ordering of the vertices) are all preserved.

Students will select and use various types of reasoning and methods of proof.

8.RP.8 Apply inductive reasoning in making and supporting mathematical conjectures.

8.RP.8a
Using geometry software, have the students use inductive reasoning to show that vertical angles are congruent.

Parallel lines cut by a transversal



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Communication Strand

Students will organize and consolidate their mathematical thinking through communication.

8.CM.1 Provide a correct, complete, coherent, and clear rationale for thought process used in problem solving.

8.CM.1a
Have students make classroom presentations on solving a multi-step equation showing a correct, complete, coherent and clear rationale for each step of the problem.

Example:	5(x -3) = 2x + 12	
	5x - 15 = 2x + 12	Simplify the left side using the distributive property
	-2x -2x	Combine like terms by moving the variables
	3x - 15 = 12	Simplify
	+15 +15	Additive inverse of -15
	$\frac{3x}{3} = \frac{27}{3}$	Simplify
		Inverse of multiplication is division
	x = 9	

8.CM.2 Provide an organized argument which explains rationale for strategy selection.

8.CM.2a
Have students solve a problem two different ways. Have them select the better strategy and explain the rationale for their choice.

8.CM.3 Organize and accurately label work

8.CM.3a
Have students solve a system of linear equations using slope-intercept. Determine the slope and y-intercept of each equation and graph on the coordinate plane. Label each of the lines and check the solution in both equations.

Students will communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

8.CM.4 Share organized mathematical ideas through the manipulation of objects, numerical tables, drawings, pictures, charts, graphs, tables, diagrams, models and symbols in written and verbal form.

8.CM.4a
Using a protractor and tracing paper, show all the congruent angles and supplementary angles when two parallel lines are cut by a transversal. Organize the information in a table.

Example:

Angles Congruent to Angle 1	Angles Supplementary to Angle 1

8.CM.5 Answer clarifying questions from others

Students will analyze and evaluate the mathematical thinking and strategies of others.

8.CM.6 Analyze mathematical solutions shared by others

8.CM.6a
Have students work on a problem using *pair-share* . Ask each student to work on a problem individually and then compare and share mathematical ideas with a partner, verbally or in writing.

8.CM.7 Compare strategies used and solutions found by others in relation to their own work

8.CM.7a
Divide the class into groups of four and have them factor a trinomial in the form of $ax^2 + bx + c$ where $a = 1$. Have each group explain to the class the method that they used to solve the problem.

8.CM.8 Formulate mathematical questions that elicit, extend, or challenge strategies, solutions, and/or conjectures of others

8.CM.8a
Have students write problems for other students to solve. After the question is posed have the students add "bonus" questions which extend or challenge the students.

Example: How many years would it take for Arnie to earn $90 on $250 at 6% interest per year?
Extension: If Arnie started with a principle of $300 instead of $250, how long would it take him to earn $90?

Students will use the language of mathematics to express mathematical ideas precisely.

8.CM.9 Increase their use of mathematical vocabulary and language when communicating with others

8.CM.9a
Have the students bring in to class a picture of a flag that has intersecting lines and a description of their flag using mathematical vocabulary. Post all of the flags. Have each student read aloud their description, with the class identifying the flag that matches the definition.

8.CM.10 Use appropriate language, representations, and terminology when describing objects, relationships, mathematical solutions, and rationale

8.CM.10a
Create graphs from given situations using appropriate language to describe how the graph was created.

Example: It takes Alice 10 minutes to walk to school at a constant rate. It takes Dylan 13 minutes to walk to school because he starts out at a constant rate but stops at the store to buy a drink then increases his pace in order to get to school on time. Have students sketch a graph for Alice and Dylan.

8.CM.11 Draw conclusions about mathematical ideas through decoding, comprehension and interpretation of mathematical visuals, symbols, and technical writing

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Connections Strand

Students will recognize and use connections among mathematical ideas.

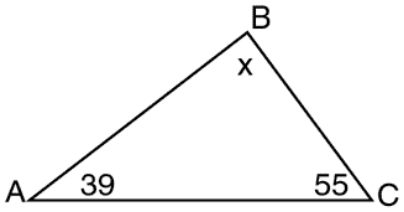
8.CN.1 Understand and make connections among multiple representations of the same mathematical idea

8.CN.1a
Have students show different verbal and algebraic representations of the same idea.

Example: the sum of a number and 7
a number increased by 7
x + 7
7 more than a number

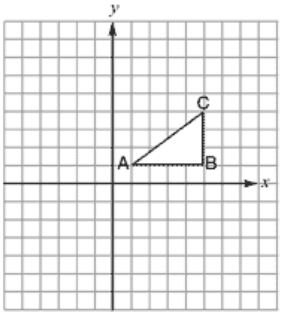
8.CN.2 Recognize connections between subsets of mathematical ideas

8.CN.2a
What is the value of x? Find the measures of the missing angles.



8.CN.3 Connect and apply a variety of strategies to solve problems

8.CN.3a
Apply the following transformations to the triangle below.



A. $R_{90°}$
B. Reflect over the y=axis
C. $T_{(-3, -4)}$
D. D_3

Graph and label each transformation.

Students will understand how mathematical ideas interconnect and build on one another to produce a coherent whole.

8.CN.4 Model situations with objects, representations and equations, draw conclusions, and formulate new situations

8.CN.4a
Model quadratics using algebra tiles. Have students factor the quadratics using the algebra tiles. Have students solve similar problems without the tiles.

8.CN.5 Understand how models in one area of mathematics can be used to solve problems in other areas of mathematics

8.CN.5a
Display a number pattern on the board. Have students write an algebraic expression for the pattern.
Example: 3, 5, 7, 9, 11, ...
Let n = the number of the term
2n + 1 is the rule for the sequence

Students will recognize and apply mathematics in contexts outside of mathematics.

8.CN.6 Recognize and provide examples of the presence of mathematics in their daily lives

8.CN.6a
Have students keep a log of the uses of mathematics throughout a one-day period. Display the logs and have the students compare the uses of mathematics in their daily lives.

8.CN.7 Apply mathematical ideas to problem situations that develop outside of mathematics.

8.CN.7a
Have the students look through a newspaper at home and find three articles which mention the use of mathematics. Bring the articles to class and share how mathematics was used in these problem situations.

8.CN.8 Investigate the presence of mathematics in careers and areas of interest

8.CN.8a
Have the students interview adults, asking how mathematics is used in their careers.

8.CN.9 Recognize and apply mathematics to other disciplines, areas of interest, and societal issues

8.CN.9a
Have students use proportional reasoning to create a scale drawing of a room they feel should be added to the school to improve education for all students. Ask students to include a brief justification about their choice of the room to be built.

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Representation Strand

Students will create and use representations to organize, record, and communicate mathematical ideas.

8.R.1 Use physical objects, drawings, charts, tables, graphs, symbols, equations, and technology as representations

8.R.1a
Using appropriate mathematical software, investigate problems related to reflections, rotations, dilations, and translations.

8.R.2 Explain, describe, and defend mathematical ideas using representations

8.R.2a
Have students determine which set of ordered pairs below could represent a function:

Set #1	Set #2
(0,1)	(5,2)
(1,2)	(5,3)
(2,3)	(6,4)
(3,4)	(7,5)

Have students explain why they chose the set that they did by describing what makes a function.

8.R.3 Recognize, compare, and use an array of representational forms

8.R.4 Explain how different representations express the same relationship

8.R.4a
Explain why $x \cdot x \cdot x \cdot x = x^4$ and how they represent the same value.

8.R.5 Use standard and non-standard representations with accuracy and detail

Students will select, apply, and translate among mathematical representations to solve problems.

8.R.6 Use models to explore problem situations

8.R.6a
Use pattern blocks or tangrams to build similar figures. Prove that they are similar by using proportional reasoning.

8.R.7 Investigate relationships between different representations and their impact on a given problem

8.R.8 Use representation as a tool for exploring and understanding mathematical ideas

8.R.8a
Use algebra tiles to investigate and understand addition and subtraction of polynomials.

Students will use representations to model and interpret physical, social, and mathematical phenomena.

8.R.9 Use math to show and understand physical phenomena (i.e., make and interpret scale drawings of figures or scale models of objects)

8.R.9a
Have students construct a scale drawing of a school or community soccer or football field.

8.R.10 Use math to show and understand social phenomena (i.e., determine profit from sale of yearbooks)

8.R.10a
Have students determine the ticket price for a school dance based upon several factors: number of students expected to attend, supplies needed, and profit desired.

8.R.11 Use math to show and understand mathematical phenomena (i.e., use tables, graphs, and equations to show a pattern underlying a function)

8.R.11a
Use a graphing calculator to explore how the slope of a line and the y-intercept determine the graph of a line. Graph the equations below using a graphing calculator:

Example: Exploring linear functions

$y = 2x - 3$
$y = 2x + 5$
$y = 2x + 7$
$y = 2x - 4$
What is the same about the graph of the lines?
What is different?
What word(s) would you use to describe the relationship of these lines?
Write the equation of another line with the same relationship.

Graph the equations below using a graphing calculator.

$y = 3x - 5$
$y = ½ x - 5$
$y = 2x - 5$
$y = -3x - 5$
What is the same about the graph of the lines?
What is different?
What can you say about the intersection?
Where do they intersect?
Write the equation of another line with the same relationship.

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Number Sense and Operations

Students will understand meanings of operations and procedures, and how they relate to one another.

Operations

8.N.1 Develop and apply the laws of exponents for multiplication and division

8.N.1a
Have students evaluate $2^3 \cdot 2^4$ and $4^3 \cdot 4^5$ and determine if they see a pattern. Have students write the rule:

When multiplying exponents with the same bases keep the base and add the exponents.

Do the same type of exercise for division. Discuss the relationship between multiplication and division. Ask students to predict what they think the rule for the division of exponents with the same base will be. Again, have students write the rule. Compare predictions.

8.N.2 Evaluate expressions with integral exponents

8.N.2a
Simplify the numeric expressions below :

$3 + 5^3$
$2 \cdot 3 + 4^2 - 1$
$5 - 2 \cdot 3 + 2$

8.N.3 Read, write and identify percents less than 1% and greater than 100 %

8.N.4 Apply percents to:

Tax
Percent increase/decrease
Simple interest
Sale price
Commission
Interest rates
Gratuities

8.N.4a
Have students calculate the sales tax at different rates, given the price and the percentage of sales tax. Examples are below:

- Find the amount of tax at 8.25% on $52.39.
- What is the total amount you would pay for a pair of jeans that cost $26.99 if the tax rate is 7.25%?
- If you buy clothes and shirts that cost $132.48, how much would you save if you shop in a county with a sales tax rate of 7.25% compared to a county with a tax rate of 8.25%?

8.N.4b
Have students calculate the percent of increase or percent of decrease. If gasoline costs $2.03 a gallon two weeks ago and it costs $2.12 this week, what is the percent of increase?

If you bought a car for $15,000 and it is now worth $12,000, what is the percent of decrease in the value?

8.N.4c
Have students calculate interest. How much interest would you pay if you borrowed $6,000 for 3 years at a rate of 3.5% per year?

8.N.4d
Have students calculate the sale price. If a jacket sells for $89.98 but it is on sale for 30% off, find the sale price. Be sure to show the relationship between percent saved and percent paid.

8.N.4e
Have students calculate the commission for sales. A salesperson earns a commission of 2% of the selling price for every new car that is sold. How much commission will a salesperson earn for a car that sells for $17,500?

8.N.4f
If a family goes to a restaurant and wants to leave a 20% gratuity, calculate the amount of the gratuity if the total of their check is $48.28. Discuss estimation.

Students will compute accurately and make reasonable estimates.

Estimation

8.N.5 Estimate a percent of a quantity, given an application

8.N.5a
There were 35,489 fans in attendance at a football game. If 20% of the fans were wearing team shirts, about how many fans were wearing team shirts?

8.N.6 Justify the reasonableness of answers using estimation

8.N.6a
Jose says that 25% of the middle school's 500 students walk to school each day. Aki say that is approximately 40 students who walk to school each day. Estimate to determine if Aki is correct and justify your response in writing.
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Algebra Strand

Students will represent and analyze algebraically a wide variety of problem solving situations.

Variables and Expressions

8.A.1 Translate verbal sentences into algebraic inequalities

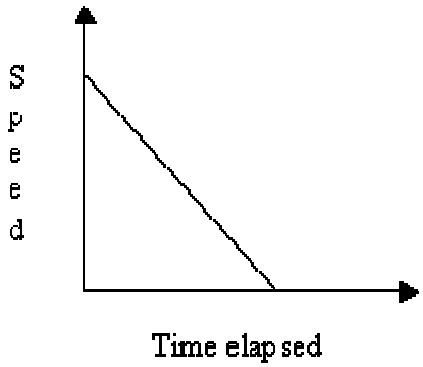
8.A.1a
Provide half of the students with index cards that contain a verbal sentence and the other half of the class with index cards that have a matching algebraic inequality. Students then move around the room to find their match. Once all the pairs are together, the person with the verbal sentence reads the card aloud to the class and the partner writes the inequality on the board so the class can verify that the match is correct.

8.A.2 Write verbal expressions that match given mathematical expressions

8.A.2a
Have students work in groups of 2 or 3. Provide each group with an algebraic expression and have each student write a different verbal expression that could be represented by the mathematical expression. Have students share their verbal expressions with the class and discuss the results, with emphasis on the use of mathematical vocabulary.

8.A.3 Describe a situation involving relationships that matches a given graph

8.A.3a
Describe a situation that could be represented by the graph below.



8.A.4 Create a graph given a description or an expression for a situation involving linear or nonlinear relationship

8.A.4a
Create a graph to represent a person who is swinging on a swing.

8.A.5 Use physical models to perform operations with polynomials

8.A.5a
Use algebra tiles to model addition and subtraction of polynomials. The algebra tiles can be made out of index cards or colorful card stock. Discuss observations. Be sure to emphasize what occurs to each term in the second polynomial involving subtraction.

For example, the tiles can be used to model the following problems:

1. $(3x^2 + 4x - 2) + (5x^2 - 7x + 5)$
2. $(2x^2 - 3x + 5) - (x^2 - 2x - 3)$
3. $5x\,(3x - 6)$

Students will perform algebraic procedures accurately.

Variables and Expressions

8.A.6 Multiply and divide monomials

8.A.6a
Have students exchange ideas on how to multiply $(5x^2y)(-2xy^2)$. Have students exchange ideas on how to divide $-30x^4y^5 \div 3x^2y^2$. Compare and contrast the difference between the multiplication and division of monomials.

8.A.6b
Have students use algebra tiles to investigate patterns when multiplying monomials. They should use their investigations to draw conclusions for rules when multiplying monomials. Based on their conjecture, multiply other monomials without the use of algebra tables.

8.A.7 Add and subtract polynomials (integer coefficients)

8.A.7a
Have each student write 3 polynomials, one on each of 3 index cards. All polynomials should have integer coefficients. Collect all the cards and shuffle them. Have students work in pairs and provide each pair with 6 cards and a penny. The cards are placed in a stack face down between the two players. Flip the penny to determine an operation: heads (addition), tails (subtraction). Flip over the first two cards and write down the polynomials with the first one flipped written down first. Ask students to perform the indicated operation. The first person to get the correct answer gets a point. If an answer is challenged and proven wrong, that player loses a point and the other player making the challenge gets the point. After students have completed those 3 problems, they trade half of their cards with another group and the remaining half with yet another group. Again, play through the cards adding onto the score. At the end of round 2, the players with the most points have the opportunity to try a challenging problem provided by the teacher, with the class assisting.

8.A.8 Multiply a binomial by a monomial or a binomial (integer coefficients)

8.A.8a
Using a chart, show the multiplication of a binomial by a monomial or binomial.

Example: $(2x + 3)(4x)$

	2x	+3
4x	$8x^2$	12x

Multiply each term on the horizontal side by each term on the vertical side. Write each term from the boxes, and add the terms $(8x^2 + 12)$

Therefore: $(2x + 3)(4x) = 8x^2 + 12$.

Example: $(3x - 5)(2x + 2)$

	3x	-5
2x	$6x^2$	-10x
+2	6x	-10

Multiply each term on the horizontal side by each term on the vertical side. Write each term from the boxes, and add the terms $6x^2$, -10x, +6x, and -10

Therefore: $(3x - 5)(2x + 2) = 6x^2 - 4x - 10$.

8.A.9 Divide a polynomial by a monomial (integer coefficients)

8.A.9a
Have students explain the following:

$$\frac{3x^2 + 9x - 12}{3} = x^2 + 3x - 4$$

$$\frac{4y^3 + 12y^2 - 8}{-2y} = -2y^2 - 6y + 4$$

8.A.10 Factor algebraic expressions using the GCF (greatest common factor)

8.A.10a
Show students how to find the GFC of $18n^2 + 12n - 6nb$ by breaking it into parts.

- Find the GCF of the coefficients:
- The GCF of 18, 12, and 6 = 6
- Find the GCF of the variables:
- The GCG of n^2, n, and nb = n

Therefore, the GCF of $18n^2 + 12n - 6nb$ is 6n. If you factor out the GCF the result is 6n(3n + 2 -b)

8.A.11 Factor a trinomial in the form $ax^2 + bx + c$; a=1 and c having no more than three sets of factors

8.A.11a
Create stations around the classroom. At each station, have 3 trinomials in the form $ax^2 + bx + c$ where a=1 and c has no more then 3 factor pairs. Divide the class into groups. Have each group rotate through the stations. At each station students should write down the trinomial and then factor it. At the last station have the correct answers, or ask students to multiply the two binomials to check their work.

8.A.12 Apply algebra to determine the measure of angles formed by or contained in parallel lines cut by a transversal and by intersecting lines

8.A.12a
Have students identify the types of angles and/or angle pairs formed when two parallel lines are cut by a transversal. Use the diagram below to find m $\angle 2$ if m $\angle 1 = 132^o$. Use the diagram below to find m $\angle 7$ if m $\angle 2 = 2x + 12$ and m $\angle 7 = 3x - 6$.

8.A.12b
Write an equation that represents the angle measures, then solve for the missing angle.

8.A.13 Solve multi-step inequalities and graph the solution set on a number line.

8.A.13a
Solve the inequality $3x + 4 \geq -8$ and graph the solution set of a number line. Solve the inequality $14 \leq -5c - 6$ and graph the solution set on a number line.

8.A.14 Solve linear inequalities by combining like terms, using the distributive property, or moving variables to one side of the inequality (include multiplication or division of inequalities by a negative number)

8.A.14a
Solve the inequality $3(m + 4) > 2m - 1$ and graph the solution set on a number line.

8.A.14b
Write out steps to solve an inequality. Cut the steps into separate strips of paper. Mix up the strips and place them in an envelope. Do this for 6 inequalities. Have students put the strips with the steps into the correct order to solve the inequality. Students should then copy the correct solution onto their answer sheet.

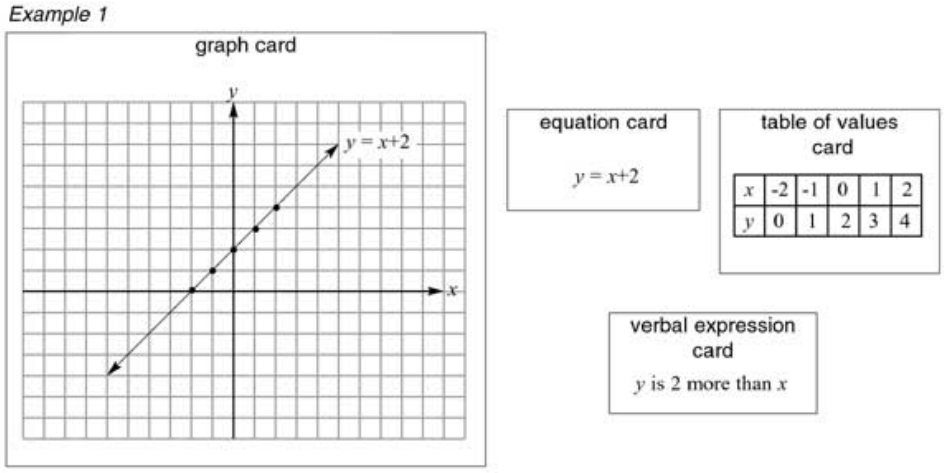
$-24 \leq 6x$
$-1/6x < 3$
$2y - 5 < 7$
$2x - 3 \geq 4x - 1$
$-3(x + 3) < 4x - 7$
$6(x + 2) > 3x - 2$

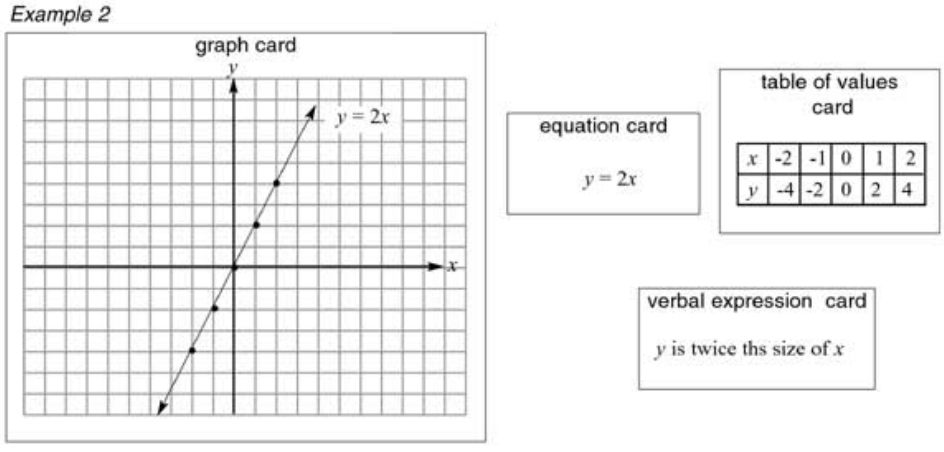
Students will recognize, use, and represent algebraically patterns, relations, and functions.

Patterns, Relations, and Functions

8.A.15 Understand that a data set can be represented in multiple ways: arithmetically, algebraically, and graphically.

8.A.15a
Create groups of cards using index cards or cardstock. For each group create an *equation* card, a *graph* card, a *table of values* card and a *verbal expression* card that all represent the same data.





Create 10 groups of cards. Shuffle the cards. Students should then sort the cards into groups, each group representing the same data.

8.A.16 Find a set of ordered pairs to satisfy a given linear numerical pattern (expressed algebraically), then plot the ordered pairs and draw the line.

8.A.16a
Ask students to find several ordered pairs that would satisfy the following equation:
y= 2x + 1.{ (-1,-1) (-2,-3) (0,1) (1,3) (2,5) .
Have students plot the points and draw the line, labeling the line.

8.A.17 Define and use correct terminology when referring to function (domain and range)

8.A.17a
Given values for a function in various forms (table, ordered pairs, etc.) students should be able to identify the set of numbers in the domain and the set of numbers in the range.

Example: Based on the table below with x representing the independent variable and y representing the dependent variable of the function, identify the domain and range.

x	0	1	2	3	4	5
y	1	2	3	4	5	6

Example: Given the function f(x) = 2x +3, given the domain of {-2,-1,0,1,2} find the range.

8.A.18 Determine if a relation is a function

8.A.18a
Based on the definition of a function, have students work in pairs to explain why the vertical line test works to identify functions.

8.A.18b
Provide students with various tables of values and ask students to identify those that are functioning and those that are not and explain their answer.

8.A.19 Interpret multiple representations using equation, table of values, and graph

8.A.19a
Provide students with any one of the following:
an equation
a table of values
a graph.
Have students write a scenario that can be represented by the equation, table and graph they were given. For example, consider the equation y = 2x + 5. A possible scenario could be: Fred's mother asked him to wash windows and agreed to pay him $5 at the start and another $2 for every window he washed.

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Geometry Strand

Students will use visualization and spatial reasoning to analyze characteristics and properties of geometric shapes.

Constructions

8.G.0 Construct the following, using a straight edge and compass:
Segment congruent to a segment
Angle congruent to an angle
Perpendicular bisector
Angle bisector

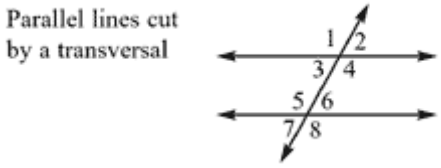
8.G.0a
Have students construct an angle bisector and stress to students the difference between a construction and a drawing. Then provide students with a picture of a construction and ask them to identify the construction.

Students will identify and justify geometric relationships, formally and informally.

Geometric Relationships

8.G.1 Identify pairs of vertical angles as congruent

8.G.1a
Using the graphic below, have students identify pairs of vertical angles. Ask students to explain how the angles are congruent.



8.G.2 Identify pairs of supplementary and complementary angles.

8.G.2a
Given various angle measures, students should be able to identify complementary and supplementary angles based on the sum of their measures.

8.G.3 Calculate the missing angle in a supplementary or complementary pair.

8.G.3a
If an angle measures 32 degrees, find its complement.

8.G.3b
Find the supplement to an angle whose measure is 67º.

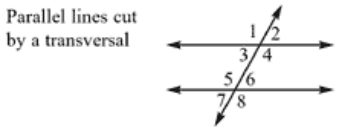
8.G.3c
If an angle is 30 degrees more than twice the measure of its complement, find the measure of the two angles.

8.G.4 Determine angle pair relationships when given two parallel lines cut by a transversal

8.G.4a
Find the following angle pairs using the diagram below and state the relationship for each angle pair.

- Vertical angles
- Alternate interior angles
- Alternate exterior angles

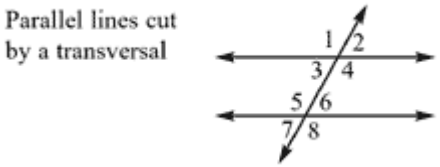
- Corresponding angles
- Linear angle pairs
- Interior angles on the same side of the transversal
- Exterior angles on the same side of the transversal.



8.G.5 Calculate the missing angle measurements when given two parallel lines cut by a transversal

8.G.5a
Using the diagram below, have students identify an angle pair relationship to the identified angle (corresponding, alternate interior, etc.). Then determine if the angle pair is congruent or supplementary and determine the angle measure.

If the measure of ∠1= 128º, find the measure of the other angles using the graphic below. Have students share how they found specific angles, reinforcing the concept that there are many approaches to solving the problem and reinforcing the different angle pair relationships.



8.G.6 Calculate the missing angle measurements when given two intersecting lines and an angle.

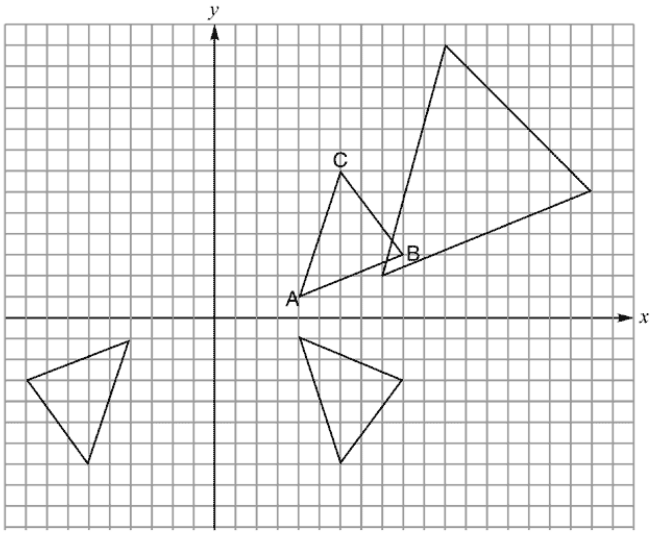
8.G.6a
Have students identify the relationship of the angles formed by two intersecting lines (vertical and congruent or linear and supplementary.) Once determined, have students calculate the measure of the missing angles.

Students will apply transformations and symmetry to analyze problem solving situations.

Transformational Geometry

8.G.7 Describe and identify transformations in the plane, using proper function notation (rotations, reflections, translations, and dilations)

8.G.7a
Using the graph below, identify which transformation is a reflection, rotation, translation, and dilation of ABC.



8.G.8 Draw an image of a figure under rotations of 90 and 180 degrees

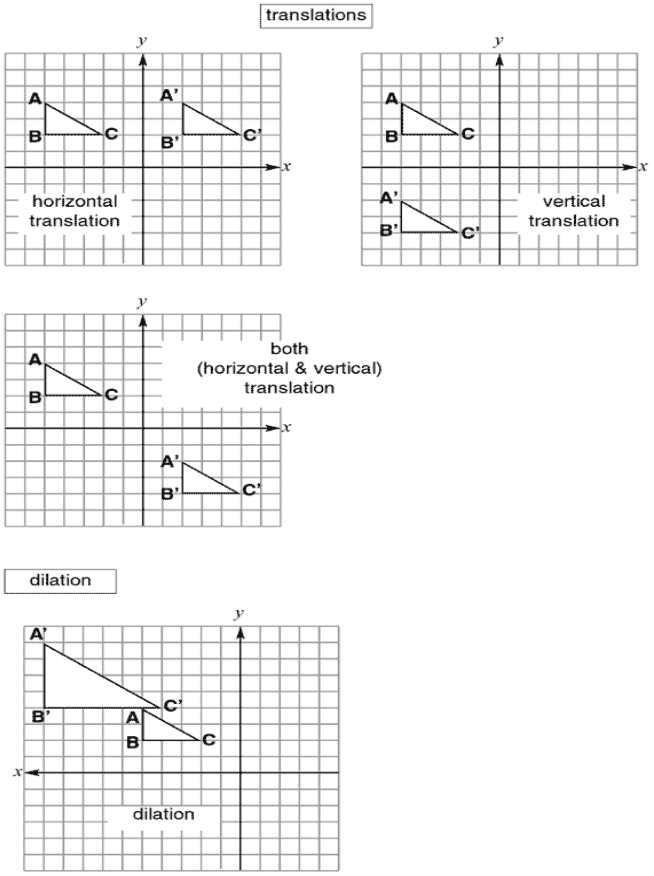
8.G.8a
Have students stand and rotate based on a given direction (e.g., 90 degrees clockwise or 270 degrees counterclockwise). Have students rotate 180 degrees clockwise and 180 degrees counterclockwise. After several rotations have students discuss relationship between clockwise and counter clockwise rotations. Students should be able to translate this to the coordinate system. Discuss what effect a transformation of 90 degrees has on the coordinates of the figure being rotated. Do the same for a transformation of 180 degrees. Ask students to make conjecture about rotating a point 90 degrees in the coordinate plan and rotating a point 180 degrees in the coordinate plan with respect to the origin.

8.G.9 Draw the image of a figure under a reflection over a given line

8.G.9a
Have two students stand facing each other. Place a yardstick or tapeline between them (x-axis). When one person moves a hand or foot, the other should mirror them. Have them name the part moved (e.g., leader's left hand mirrored by the image person's right hand). After several moves, switch roles. Next have the students stand side by side and complete the same activity. A line should be placed in between the two (y-axis). Discuss the results and have students demonstrate their findings on a figure in a coordinate plane. Have students make generalization about the effect of reflecting a point in the x-axis and y-axis.

8.G.10 Draw the image of a figure under a translation

8.G.10a
Students should know that a translation may involve one or two moves (horizontal only, vertical only, or vertical and horizontal). Place tape on the classroom floor down the middle to represent the y-axis and a piece of tape across the room to represent the x-axis. Ask a student to stand at a given point and translate three units to the right and five units forward. Model other translations with other students, or have several students represent a unique point and model all points under the same translation. Discuss the results and have students demonstrate their findings in the coordinate plane for a given point. Provide students with a figure and the constant of dilation and ask them to find the lengths of the image. Provide the original figure and its image under a dilation and ask students to determine the constant dilation. Have students discuss the effect on angle measurements of the image.



8.G.12 Identify the properties preserved and not preserved under reflection, rotation, translation, and dilation

8.G.12a
List the different transformations (i.e., reflection, rotation, translation and dilation) on the board. Have students identify properties of a given figure and then indicate which properties (e.g., angle measure, length of segments, orientation, congruence) of the given figure remain the same under each transformation and which properties change and how they change. Discuss the results.

Students will apply coordinate geometry to analyze problem-solving situations

Coordinate Geometry

8.G.13 Determine the slope of a line from a graph and explain the meaning of slope as a constant rate of change

8.G.13a
Have students work in pairs to create a table of values for the equations below:

$y = x$ $y = x + 1$ $y = x + 3$

Using chart size graph paper and a straw to represent a straight segment, have one of the students place the straw on the chart paper to represent the graph of the line represented by the equation y=x. Have another student place a second straw to represent the graph of the line represented by the equation y = x + 1. Have a student place a third straw to represent the graph of the line represented by the equation y= x -3. Discuss how the graphs changed based on the equations. Give students several more equations with a slope of one and where only the y-intercept changes, and ask them to place straws to represent the graphs without completing a table of values.

Next have students create a table of values for the equations below:

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

Follow the same procedure as before with students using straws to represent each graph of the equations. Compare the graphs and compare the equations. Discuss how the slope changes each time. Give students several more equations with different slopes and a y-intercept of one and ask them to use straws to graph the equations.

Finally, give students equations in the form y= mx + b and ask them to graph the lines represented by the equations based on the equations graphed earlier, using the information discussed.

Have students complete a table of values for each equation. Students could use a graphing calculator or a computer to graph the equations and note similarities and differences.

Students should recognize that slope is a way to describe the "steepness" of a line and understand that slope is a constant value between any two points on the line. Given any two points (x_1,y_1) and (x_2,y_2) on a line the slope can be calculated by

$$\frac{y_1 - y_2}{x_1 - x_2}$$

8.G.13b
Given the graph of a line, have students identify any two points on the line and using those two points, determine the slope of the line. Have students identify two other points on the line and using those two points determine the slope of the line. Discuss their findings.

8.G.14 Determine the y – intercept of a line from the graph and be able to explain the y- intercept.

8.G.14a
Display the graphs of several linear equations and have the students identify the coordinates of the y-intercept. Students should be able to identify the y-intercept as the point where the graph of the equation crosses the y-axis. They should also recognize that the x value of any y-intercept is zero.

8.G.15 Graph a line using a table of values

8.G.15a
Given an equation in the form y = mx + b, have students create a table of values by substituting values for x and finding the corresponding y values. When graphing those points students should anticipate a line and look for any values that might be in error. Also, remind students to label the points, label the line with the equation, and label the axes.

8.G.16 Determine the equation of a line given the slope and the y-intercept

8.G.16a
Have students write down a value for the slope of a line and the y-intercept of a line. Have them switch with another student and write the equation of the line for the values they are given in the form y = mx + b. Students should be familiar with the y = mx + b form and that the slope is represented by m and the y-intercept is represented by b. The equation is determined by substituting in the values for slope and the y-intercept.

8.G.17 Graph a line from an equation in slope-intercept form *(y = mx + b)*

8.G.17a
Create a large coordinate system by using chalk or masking tape on the floor to identify the x- and y-axes. Have the first student identify the coordinates of the y- intercept and stand at that point. Have the next student state the slope and move from the first person to the new point. Have the third person state the slope, start at the second student's position and move to the next point. Have the fourth student go by the first student and state the slope to move in the opposite direction and then move to that point. Have the fifth student start from the fourth student's position, state the slope and continue moving in that direction and stand at the next point on the line. Other students use tape or yarn to connect the "points." They should be sure to include arrows on the ends of the line to indicate that the line continues. Note: Student should identify the slope and the y-intercept in the equation. They should be sure to write slope and not "m = " when identifying the slope. They should also be sure to identify the y-intercept and not use "b=". They should know that the y-intercept identifies a point from the line and is used as a starting point. The slope gives direction to subsequent points. Students should be sure to label the graph with the equation on the line.

8.G.18 Solve systems of equations graphically (only linear, integral solutions, y = mx + b format, no vertical/horizontal lines)

8.G.18a
Inform students that they are being asked to find a buried treasure. They are told the location is identified on a "map" (a coordinate system) and to find the treasure they must identify the solution set to a system of equations.

8.G.19 Graph the solution set of an inequality on a number line

8.G.19a
Provide the graphs of the following inequalities and ask students to match the four graphs to the four inequalities.
($x < -4$, $x \geq -4$, $x \leq -4$ and $x > -4$.)

8.G.20 Distinguish between linear and nonlinear equations $ax^2 + bx + c$; a=1 (only graphical)

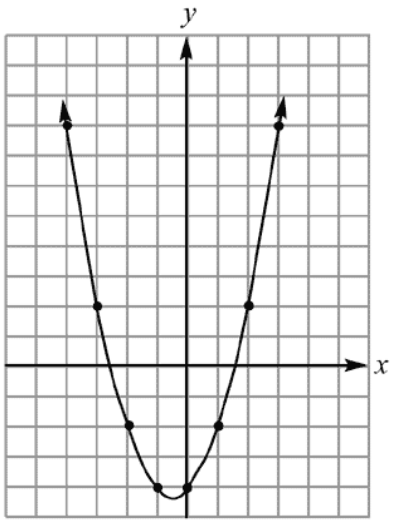
8.G.20a

Have students graph the solutions for several linear equations and several quadratic equations. Have students identify the differences in the graphs of each (straight line, "U", differences in direction). Discuss which equations have lines with a positive slope, negative slope, and which quadratics have a "U" turned up and which are turned down.

Have students stand to model the graph of a linear equation and a quadratic equation. Tell the students that they are the y-axis and they will use their arms to represent the graph of the equation. Discuss which arm is up and which is down, and when both arms are up. Be sure equations are written large enough for students to see. When an equation is shown to them, they must use their arms to model the graph of the equation.

$y = x^2 + x - 4$

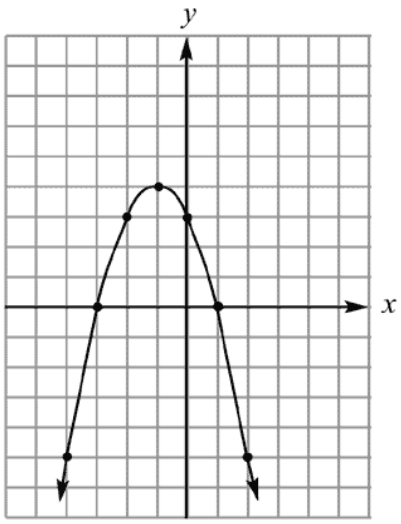
x	$x^2 + x - 4$	y
-4	$(-4)^2 - 4 - 4$	8
-3	$(-3)^2 - 3 - 4$	2
-2	$(-3)^2 - 2 - 4$	-2
-1	$(-1)^2 - 1 - 4$	-4
0	$0 - 0 - 4$	-4
1	$1^2 + 2 - 4$	-2
2	$2^2 + 2 - 4$	2
3	$3^2 + 3 - 4$	8



or

$y = -x^2 - 2x + 3$

x	$x^2 + x - 4$	y
-4	$(-4)^2 - 2(-4) - 3$	-5
-3	$(-3)^2 - 2(-3) - 3$	0
-2	$(-2)^2 - 2(-3) - 3$	3
-1	$(-1)^2 - 2(-1) - 3$	4
0	$0 - 0 + 3$	3
1	$(1)^2 - 2(1) + 3$	0
2	$(2)^2 - 2(2) + 3$	-5



8.G.21 Recognize the characteristics of quadratics in tables, graphs, equations and situations

8.G.21b
Ask the students to determine which of the following methods would best illustrate the difference between a linear and a quadratic function:

- Compare tables of values.
- Compare graphs.
- Compare equations.
- Compare situations

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Measurement Strand

Students will determine what can be measured and how, using appropriate methods and formulas.

Units of Measurement

8.M.1 Solve equations/proportions to convert to equivalent measurements within metric and customary measurement systems *(Note: also allow Fahrenheit to Celsius and vice versa)*

8.M.1a
Calculate how many minutes will have passed in one year.
A machine holds 5 gallons of lemonade. If you only have quart bottles, how many bottles would you need to empty the machine?

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