Merrimack School District
Mathematics Curriculum

PRE-ALGEBRA
Grades 7 & 8

Standards for Mathematical Practice

The College and Career Readiness 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.

Standards for Mathematical Practice	Explanations and Examples
1. Make sense of problems and persevere in solving them.	In grade 8, students solve real world problems through the application of algebraic and geometric concepts. 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.	In grade 8, students represent a wide variety of real world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. They examine patterns in data and assess the degree of linearity of functions. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.
3. Construct viable arguments and critique the reasoning of others.	In grade 8, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like "How did you get that?", "Why is that true?" "Does that always work?" They explain their thinking to others and respond to others' thinking.
4. Model with mathematics.	In grade 8, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students solve systems of linear equations and compare properties of functions provided in different forms. Students use scatterplots to represent data and describe associations between variables. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context.

Standards for Mathematical Practice	Explanations and Examples
5. Use appropriate tools strategically.	Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 8 may translate a set of data given in tabular form to a graphical representation to compare it to another data set. Students might draw pictures, use applets, or write equations to show the relationships between the angles created by a transversal.
6. Attend to precision.	In grade 8, 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 the number system, functions, geometric figures, and data displays.
7. Look for and make use of structure.	Students routinely seek patterns or structures to model and solve problems. In grade 8, students apply properties to generate equivalent expressions and solve equations. Students examine patterns in tables and graphs to generate equations and describe relationships. Additionally, students experimentally verify the effects of transformations and describe them in terms of congruence and similarity.
8. Look for and express regularity in repeated reasoning.	In grade 8, students use repeated reasoning to understand algorithms and make generalizations about patterns. Students use iterative processes to determine more precise rational approximations for irrational numbers. They analyze patterns of repeating decimals to identify the corresponding fraction. During multiple opportunities to solve and model problems, they notice that the slope of a line and rate of change are the same value. Students flexibly make connections between covariance, rates, and representations showing the relationships between quantities.

Grade 8 Critical Areas

The Critical Areas are designed to bring focus to the standards at each grade by describing the big ideas that educators can use to build their curriculum and to guide instruction. The Critical Areas for eighth grade can be found in the *College and Career Readiness Standards for Mathematics*.

1. **Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations**
   Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ($y/x = m$ or $y = mx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount $m{\cdot}A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.

   Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

2. **Grasping the concept of a function and using functions to describe quantitative relationships**
   Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

3. **Analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem**
Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

Grade 8 Overview

The Number System
- Know that there are numbers that are not rational, and approximate them to rational numbers.

Expressions and Equations
- Work with radicals and integer exponents.
- Understand the connections between proportional relationships, lines, and linear equations.
- Analyze and solve linear equations and pairs of simultaneous linear equations.

Functions
- Define, evaluate, and compare functions.
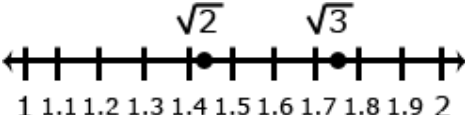- Use functions to model relationships between quantities.

Geometry
- Understand congruence and similarity using physical models, transparencies, or geometry software.
- Understand and apply the Pythagorean Theorem.
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

Statistics and Probability
- Investigate patterns of association in bivariate data.

The Number System	8.NS
College and Career Readiness Cluster	
Know that there are numbers that are not rational, and approximate them by rational numbers.	

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: **Real Numbers, Irrational numbers, Rational numbers, Integers, Whole numbers, Natural numbers, radical, radicand, square roots, perfect squares, cube roots, terminating decimals, repeating decimals, truncate**

Enduring Understandings:

In real world problem solving, it is sometimes necessary to use approximations or substitutions because of the limits of our numerical representations.

Essential Questions:

How do we classify real numbers?

How can rational numbers be represented and how can they be used?

How do you estimate the value of irrational numbers to help solve problems?

College and Career Readiness Standards *Students are expected to:*	Mathematical Practices	Unpacking Explanations and Examples *What does this standard mean that a student will know and be able to do?*
8.NS.A.1 Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers	*8.MP.2.* Reason abstractly and quantitatively. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	Students understand that Real numbers are either rational or irrational. They distinguish between rational and irrational numbers, recognizing that any number that can be expressed as a fraction is a rational number. The diagram below illustrates the relationship between the subgroups of the real number system. **Real Numbers** All real numbers are either rational or irrational Rational Integers Whole Natural Irrational

| show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. | | Students recognize that the decimal equivalent of a fraction will either terminate or repeat. Fractions that terminate will have denominators containing only prime factors of 2 and/or 5. This understanding builds on work in 7th grade when students used long division to distinguish between repeating and terminating decimals.

Students convert repeating decimals into their fraction equivalent using patterns or algebraic reasoning.
One method to find the fraction equivalent to a repeating decimal is shown below.

Example 1:
Change $0.\overline{4}$ to a fraction.

- Let $x = 0.444444…..$

- Multiply both sides so that the repeating digits will be in front of the decimal. In this example, one digit repeats so both sides are multiplied by 10, giving $10x = 4.4444444….$

- Subtract the original equation from the new equation.

$$\begin{aligned} 10x &= 4.4444444…. \\ -x &= 0.444444….. \\ \hline 9x &= 4 \end{aligned}$$

- Solve the equation to determine the equivalent fraction.
$$\frac{9x}{9} = \frac{4}{9}$$
$$x = \frac{4}{9}$$

Additionally, students can investigate repeating patterns that occur when fractions have denominators of 9, 99, or 11.

Example 2:
$\frac{4}{9}$ is equivalent to $0.\overline{4}$, $\frac{5}{9}$ is equivalent to $0.\overline{5}$, etc. |

| 6.NS.A.2. <mark>Use rational approximations of irrational numbers</mark> to compare the size of irrational numbers, locate them approximately on a number line diagram, and <mark>estimate</mark> the <mark>value of expressions</mark> (e.g., π^2). *For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.* | *8.MP.2.* Reason abstractly and quantitatively.

8.MP.4. Model with mathematics.

8.MP.7. Look for and make use of structure.

8.MP.8. Look for and express regularity in repeated reasoning. | Students can approximate square roots by iterative processes.

Examples:
● Approximate the value of $\sqrt{5}$ to the nearest hundredth.

$\sqrt{5}$

$\sqrt{5}$

$\sqrt{5}$

● Compare √2 and √3 by estimating their values, plotting them on a number line, and making comparative statements.

$$\sqrt{2} \qquad \sqrt{3}$$
1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2

Solution: Statements for the comparison could include:
○ √2 is approximately 0.3 less than √3
○ √2 is between the whole numbers 1 and 2
　√3 is between 1.7 and 1.8 |

Expressions and Equations	8.EE

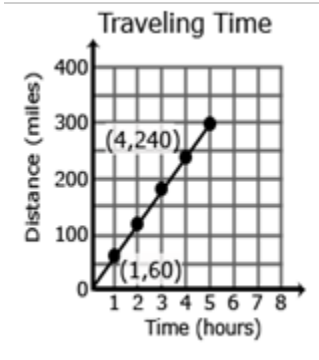**College and Career Readiness Cluster**

Work with radicals and integer 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: **laws of exponents, power, perfect squares, perfect cubes, root, square root, cube root, scientific notation, standard form of a number.** Students should also be able to read and use the symbol: ±

Enduring Understandings:

Understand, represent and solve linear relationships.

Patterns of numbers correspond to algebraic expressions that can be used for problem solving.

Essential Questions:

How are the properties of integer exponents used to generate equivalent numerical expressions?

How can scientific and decimal notation be used to solve problems with very small and/or very large numbers?

How is the slope (a.k.a. rate of change) of a line determined?

How are linear equations with one variable solved?

What does the solution to a system of equations represent and how do we find it?

What is the relationship between radicals and integer exponents?

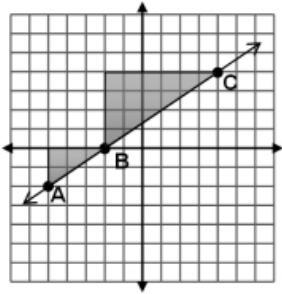| College and Career Readiness Standards *Students are expected to:*	Mathematical Practices	Unpacking Explanations and Examples *What does this standard mean that a student will know and be able to do?*
8.EE.A.1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.*	*8.MP.2.* Reason abstractly and quantitatively. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision.	**Examples:** • $\dfrac{4^3}{5^2} = \dfrac{64}{25}$ • $\dfrac{4^3}{4^7} = 4^{3-7} = 4^{-4} = \dfrac{1}{4^4} = \dfrac{1}{256}$ $\dfrac{4^{-3}}{5^2} = 4^{-3} \times \dfrac{1}{5^2} = \dfrac{1}{4^3} \times \dfrac{1}{5^2} = \dfrac{1}{64} \times \dfrac{1}{25} = \dfrac{1}{16,000}$

8.EE.A.2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.	8.MP.7. Look for and make use of structure.	
	8.MP.2. Reason abstractly and quantitatively.	**Examples**:
	8.MP.5. Use appropriate tools strategically.	• $3^2 = 9$ and $\sqrt{9} = \pm 3$
	8.MP.6. Attend to precision.	• $\left(\dfrac{1}{3}\right)^3 = \left(\dfrac{1^3}{3^3}\right) = \dfrac{1}{27}$ and $\sqrt[3]{\dfrac{1}{27}} = \dfrac{\sqrt[3]{1}}{\sqrt[3]{27}} = \dfrac{1}{3}$
	8.MP.7. Look for and make use of structure.	• Solve $x^2 = 9$
		• Solution: $x^2 = 9$
		• $\sqrt{x^2} = \pm\sqrt{9}$
		• $x = \pm 3$
		• Solve $x^3 = 8$
		• Solution: $x^3 = 8$
		• $\sqrt[3]{x^3} = \sqrt[3]{8}$
		$x = 2$
8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many	8.MP.2. Reason abstractly and quantitatively. 8.MP.5. Use appropriate tools strategically. 8.MP.6. Attend to precision.	Students use scientific notation to express very large or very small numbers. Students compare and interpret scientific notation quantities in the context of the situation, recognizing that if the exponent increases by one, the value increases 10 times. Likewise, if the exponent decreases by one, the value decreases 10 times. Students solve problems using addition, subtraction or multiplication, expressing the answer in scientific notation. **Example 1:** Write 75,000,000,000 in scientific notation. **Solution:** 7.5×10^{10}

times as much one is than the other. E.g. estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world *population is more than 20 times larger*.		**Example 2:** Write 0.0000429 in scientific notation. ***Solution:*** 4.29 x 10^{-5} **Example 3:** Express 2.45 x 10^5 in standard form. ***Solution:*** 245,000 **Example 4:** How much larger is 6 x 10^5 compared to 2 x 10^3 ***Solution:*** 300 times larger since 6 is 3 times larger than 2 and 10^5 is 100 times larger than 10^3. **Example 5:** Which is the larger value: 2 x 10^6 or 9 x 10^5? ***Solution:*** 2 x 10^6 because the exponent is larger
8.EE.A.4 <mark>Perform</mark> operations with numbers expressed in <mark>scientific notation</mark>, including problems where both decimal and scientific notation are used. <mark>Use scientific notation and choose units of appropriate size for measurements of</mark> very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret	*8.MP.2.* Reason abstractly and quantitatively. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision.	Students understand scientific notation as generated on various calculators or other technology. Students enter scientific notation using E or EE (scientific notation), * (multiplication), and ^ (exponent) symbols. **Example 1:** 2.45E+23 is 2.45 x 10^{23} and 3.5E-4 is 3.5 x 10^{-4} (NOTE: There are other notations for scientific notation depending on the calculator being used.) Students add and subtract with scientific notation. **Example 2:** In July 2010, there were approximately 500 million Facebook users. In July 2011, there were approximately 750 million Facebook users. How many more users were there in 2011? Write your answer in scientific notation. ***Solution:*** Subtract the two numbers: 750,000,000 - 500,000,000 = 250,000,000 → 2.5 x 10^8

| scientific notation that has been generated by technology. | | Students use laws of exponents to multiply or divide numbers written in scientific notation, writing the product or quotient in proper scientific notation.

Example 3:
$(6.45 \times 10^{11})(3.2 \times 10^4) = (6.45 \times 3.2)(10^{11} \times 10^4)$ *Rearrange factors*
                           $= 20.64 \times 10^{15}$ *Add exponents when multiplying powers of 10*
                           $= 2.064 \times 10^{16}$ *Write in scientific notation*

Example 4:
$\dfrac{3.45 \times 10^5}{6.7 \times 10^{-2}}$ $\dfrac{6.3}{1.6}$ $10^{5-(-2)}$ *Subtract exponents when dividing powers of 10*
                   $= 0.515 \times 10^7$ *Write in scientific notation*
                   $= 5.15 \times 10^6$ |

College and Career Readiness Cluster

Understand the connections between proportional relationships, lines, and linear equations.

College and Career Readiness Standards *Students are expected to:*	Mathematical Practices	Unpacking Explanations and Examples *What does this standard mean that a student will know and be able to do?*
8.EE.B.5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional	*8.MP.1.* Make sense of problems and persevere in solving them. *8.MP.2.* Reason abstractly and quantitatively.	Using graphs of experiences that are familiar to students, increases accessibility and supports understanding and interpretation of proportional relationship. Students are expected to both sketch and interpret graphs.

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relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*	*8.MP.3.* Construct viable arguments and critique the reasoning of others. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure. *8.MP.8.* Look for and express regularity in repeated reasoning.	**Example**: Compare the scenarios to determine which represents a greater speed. Include a description of each scenario including the unit rates in your explanation. $y = 50x$ x is time in hours y is distance in miles

| 8.EE.B.6 Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b. | 8.*MP.2*. Reason abstractly and quantitatively.

8.*MP.3*. Construct viable arguments and critique the reasoning of others.

8.*MP.4*. Model with mathematics.

8.*MP.5*. Use appropriate tools strategically.

8.*MP.7*. Look for and make use of structure.

8.*MP.8*. Look for and express regularity in repeated reasoning. | Triangles are similar when there is a constant rate of proportionality between them. Using a graph, students construct triangles between two points on a line and compare the sides to understand that the slope (ratio of rise to run) is the same between any two points on a line.
Example 1:
The triangle between A and B has a vertical height of 2 and a horizontal length of 3. The triangle between B and C has a vertical height of 4 and a horizontal length of 6.

$$\frac{2}{3}$$

Given an equation in slope-intercept form, students graph the line represented.

Students write equations in the form $y = mx$ for lines going through the origin, recognizing that m represents the slope of the line.

 |

Example 2:

Write an equation to represent the graph to the right.

Solution:

$y = -\dfrac{3}{2} x$

College and Career Readiness Cluster

Analyze and solve linear equations and pairs of simultaneous linear equations.

College and Career Readiness Standards *Students are expected to:*	Mathematical Practices	Unpacking Explanations and Examples *What does this standard mean that a student will know and be able to do?*

8.EE.C.7. Solve linear equations in one variable.
 	
a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, *a*
	8.MP.2. Reason abstractly and quantitatively.
	
	8.MP.5. Use appropriate tools strategically.
	
	8.MP.6. Attend to precision.
	
	8.MP.7. Look for and make use of structure.
		As students transform linear equations in one variable into simpler forms, they discover the equations can have one solution, infinitely many solutions, or no solutions.
		
		When the equation has one solution, the variable has one value that makes the equation true as in $12 - 4y = 16$. The only value for y that makes this equation true is -1.
		
		When the equation has infinitely many solutions, the equation is true for all real numbers as in $7x + 14 = 7(x+2)$. As this equation is simplified, the variable terms cancel leaving $14 = 14$ or $0 = 0$. Since the expressions are equivalent, the value for the two sides of the equation will be the same regardless which real number is used for the substitution.
		
		When an equation has no solutions it is also called an inconsistent equation. This is the case when the two expressions are not equivalent as in $5x - 2 = 5(x+1)$. When simplifying this equation, students will find that the solution appears to be two numbers that are not equal or $-2 = 1$. In this case, regardless which real number is used for the substitution, the equation is not true and therefore has no solution.
		
		Examples:
		
		• Solve for x:
		
		    ○ $-3(x+7) = 4$
		
		    ○ $3x - 8 = 4x - 8$
		
		    ○ $3(x+1) - 5 = 3x - 2$

= a, or $a = b$ results (where a and b are different numbers).
 	
b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
		• Solve: (Model solving with students)
		
		     ○ $7(m - 3) = 7$
		
		     ○ $\dfrac{1}{4} - \dfrac{2}{3}y = \dfrac{3}{4} - \dfrac{1}{3}y$

8.EE.C.8 Analyze and solve pairs of simultaneous linear equations. a. Understand that solutions to a system of two linear equations in	*8.MP.1.* Make sense of problems and persevere in solving them. *8.MP.2.* Reason abstractly and quantitatively. *8.MP.3.* Construct viable arguments	Systems of linear equations can also have one solution, infinitely many solutions or no solutions. Students will discover these cases as they graph systems of linear equations and solve them algebraically. Students graph a system of two linear equations, recognizing that the ordered pair for the point of intersection is the *x*-value that will generate the given *y*-value for both equations. Students recognize that graphed lines with one point of intersection (different slopes) will have one solution, parallel lines (same slope, different *y*-intercepts) have no solutions, and lines that are the same (same slope, same *y*-intercept) will have infinitely many solutions. **Example 1:**

two variables correspond to ==points of intersection== of their graphs, because points of intersection satisfy both equations simultaneously.

b. ==Solve== systems of two linear equations in two variables algebraically, and ==estimate solutions== by ==graphing== the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.*

and critique the reasoning of others.

8.MP.4. Model with mathematics.

8.MP.5. Use appropriate tools strategically.

8.MP.6. Attend to precision.

8.MP.7. Look for and make use of structure.

8.MP.8. Look for and express regularity in repeated reasoning.

1. Plant A and Plant B are on different watering schedules. This affects their rate of growth. Compare the growth of the two plants to determine when their heights will be the same.

Solution:

Let W = number of weeks

Let H = height of the plant after W weeks

Plant A		
W	H	
0	4	(0,4)
1	6	(1,6)
2	8	(2,8)
3	10	(3,10)

Plant B		
W	H	
0	2	(0,2)
1	6	(1,6)
2	10	(2,10)
3	14	(3,14)

2. Based on the coordinates from the table, graph lines to represent each plant.

Solution:
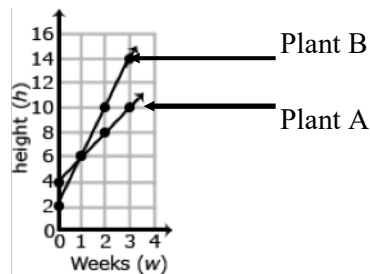
3. Write an equation that represents the growth rate of Plant A and Plant B.

c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*		**Solution:** Plant A $H = 2W + 4$ Plant B $H = 4W + 2$ 4. At which week will the plants have the same height? **Solution***:* $\quad$ 2W + 4 = 4W + 2 $\qquad$ *Set height of Plant A* $\quad$ *equal to height of Plant B* $\quad$ 2W – 2W + 4 = 4W – 2W+ 2 $\qquad$ *Solve for W* $\quad$ 4 = 2W + 2 $\quad$ 4 – 2 = 2W + 2 – 2 $\quad\dfrac{2}{2} = \dfrac{2W}{2}$ $\quad$ 1 = W After one week, the height of Plant A and Plant B are both 6 inches. *Check:* $\;$ 2(1) + 4 = 4(1) + 2 $\qquad\quad$ 2 + 4 = 4 + 2 $\qquad\qquad$ 6 = 6

Functions		8.F

College and Career Readiness Cluster

Define, evaluate, and compare 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: **functions, *y*-value, *x*-value, vertical line test, input, output, rate of change, linear function, non-linear function**

Enduring Understandings:
The patterns and relationships described by functions can be represented graphically, numerically, symbolically, and verbally.

Essential Questions:
What is a function?
How can functions represented in multiple ways be compared?
How is it determined if a function is linear or non-linear?
How do changes in the representation of functions change as a result of changes in their equations?
How are the initial value and rate of change determined?
How can a functional relationship modeled in a graph be described qualitatively?

College and Career Readiness Standards *Students are expected to:*	Mathematical Practices	Unpacking Explanations and Examples *What does this standard mean that a student will know and be able to do?*
8.F.A.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	*8.MP.2.* Reason abstractly and quantitatively. *8.MP.6.* Attend to precision	Students understand rules that take *x* as input and gives *y* as output is a function. Functions occur when there is exactly one *y*-value is associated with any *x*-value. Using *y* to represent the output we can represent this function with the equations $y = x^2 + 5x + 4$. Students are **not** expected to use the function notation *f(x)* at this level. Students identify functions from equations, graphs, and tables/ordered pairs. **Graphs** Students recognize graphs such as the one below is a function using the vertical line test, showing that each *x*-value has only one *y*-value;

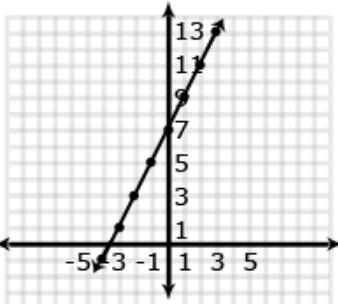| Function notation is not required in Grade 8. | |
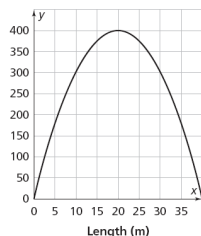
whereas, graphs such as the following are not functions since there are 2 y-values for multiple x-value.
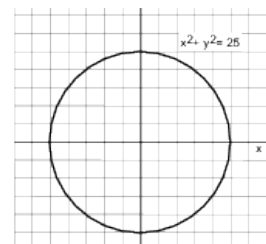
Tables or Ordered Pairs
Students read tables or look at a set of ordered pairs to determine functions and identify equations where there is only one output (y-value) for each input (x-value).

Functions   Not A Function

<table><tr><td>**x**</td><td>**y**</td></tr><tr><td>0</td><td>3</td></tr><tr><td>1</td><td>9</td></tr><tr><td>2</td><td>27</td></tr></table>
<table><tr><td>**x**</td><td>**y**</td></tr><tr><td>16</td><td>4</td></tr><tr><td>16</td><td>-4</td></tr><tr><td>25</td><td>5</td></tr><tr><td>25</td><td>-5</td></tr></table>

{(0, 2), (1, 3), (2, 5), (3, 6)}

Equations
Students recognize equations such as $y = x$ or $y = x^2 + 3x + 4$ as functions; whereas, equations such as $x^2 + y^2 = 25$ are not functions. |
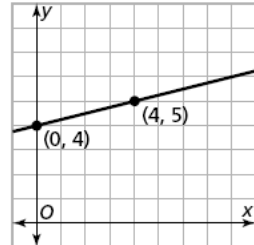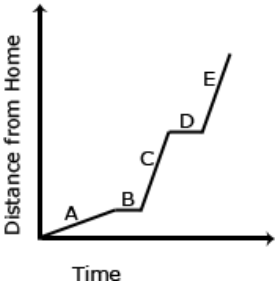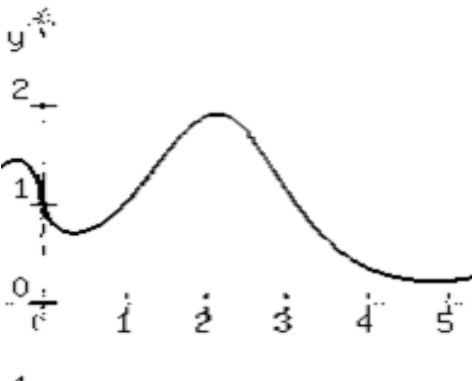
8.F.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*	*8.MP.2.* Reason abstractly and quantitatively. *8.MP.6.* Attend to precision.	Compare the two linear functions listed below and determine which equation represents a greater rate of change. **Example 1:** **Function 1:** **Function 2:** The function whose input x and output y are related by $$y = 3x + 7$$ - Compare the two linear functions listed below and determine which has a negative slope. **Example 2:** **Function 1:** Gift Card Samantha starts with $20 on a gift card for the book store. She spends $3.50 per week to buy a magazine. Let y be the amount remaining as a function of the number of weeks, x.

x	y
0	20
1	16.50
2	13.00
3	9.50
4	6.00

Function 2: Calculator Rental

The school bookstore rents graphing calculators for $5 per month. It also collects a non-refundable fee of $10.00 for the school year. Write the rule for the total cost (c) of renting a calculator as a function of the number of months (m).
Solution:

Function 1 is an example of a function whose graph has negative slope. Samantha starts with $20 and spends money each week. The amount of money left on the gift card decreases each week. The graph has a negative slope of -3.5, which is the amount the gift card balance decreases with Samantha's weekly magazine purchase.
Function 2 is an example of a function whose graph has positive slope. Students pay a yearly nonrefundable fee for renting the calculator and pay $5 for each month they rent the calculator. This function has a positive slope of 5 which is the amount of the monthly rental fee. An equation for Example 2 could be $c = 5m + 10$.

8.F.A.3 <mark>Interpret</mark> the equation $y = mx + b$ as defining a <mark>linear function</mark>, whose graph is a straight line; <mark>give</mark> examples of functions that are	*8.MP.2.* Reason abstractly and quantitatively.
	
	8.MP.4. Model with mathematics.
		Determine which of the functions listed below are linear and which are not linear and explain your reasoning.
		
		   o $y = -2x^2 + 3$ non linear, exponential
		   o $y = 2x$ linear
		   o $A = \pi r^2$ non linear, exponential
		   o $y = 0.25 + 0.5(x - 2)$ linear

not linear. *For example, the function A = s² giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.*	*8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	
8.F.B.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear	8.MP.1. Make sense of problems and persevere in solving them. 8.MP.2. Reason abstractly and quantitatively. 8.MP.3. Construct viable arguments and critique the reasoning of others. 8.MP.4. Model with mathematics. 8.MP.5. Use appropriate tools strategically.	**Example 1:** The table below shows the cost of renting a car. The company charges $45 a day for the car as well as charging a one-time $25 fee for the car's navigation system (GPS). Write an expression for the cost in dollars, c, as a function of the number of days, d. Students might write the equation $c = 45d + 25$ using the verbal description or by first making a table. <table><tr><td>Days (d)</td><td>Cost (c) in dollars</td></tr><tr><td>1</td><td>70</td></tr><tr><td>2</td><td>115</td></tr><tr><td>3</td><td>160</td></tr><tr><td>4</td><td>205</td></tr></table> Students should recognize that the rate of change is 45 (the cost of renting the car) and that initial cost (the first day charge) also includes paying for the navigation system. Classroom discussion about one time fees vs. recurrent fees will help students model contextual situations.

| function in terms of the situation it models, and in terms of its graph or a table of values. | 8.MP.6. Attend to precision.

8.MP.7. Look for and make use of structure.

8.MP.8. Look for and express regularity in repeated reasoning. | **Example 2:**
Write an equation that models the linear relationship in the table below. |

Example 2:

Write an equation that models the linear relationship in the table below.

x	y
-2	8
0	2
1	-1

Solution:
The *y*-intercept in the table below would be (0, 2). The distance between 8 and -1 is 9 in a negative direction → -9; the distance between -2 and 1 is 3 in a positive direction. The slope is the ratio of rise to run or $\frac{y}{x}$ or $\frac{-9}{3}$ = -3. The equation would be $y = -3x + 2$

Graphs:
Using graphs, students identify the *y*-intercept as the point where the line crosses the *y*-axis and the slope as the rise

run

Example 3:
Write an equation that models the linear relationship in the graph below.

Solution:
The *y*-intercept is 4. The slope is ¼ , found by moving up 1 and right 4 going from (0, 4) to (4, 5).
The linear equation would be $y = ¼ x + 4$.

8.F.B.5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	8.MP.2. Reason abstractly and quantitatively. 8.MP.3. Construct viable arguments and critique the reasoning of others. 8.MP.4. Model with mathematics. 8.MP.5. Use appropriate tools strategically. 8.MP.6. Attend to precision. 8.MP.7. Look for and make use of structure.	Given a verbal description of a situation, students sketch a graph to model that situation. Given a graph of a situation, students provide a verbal description of the situation.

Example 1:
The graph below shows a John's trip to school. He walks to his Sam's house and, together, they ride a bus to school. The bus stops once before arriving at school.

Describe how each part A – E of the graph relates to the story.
Solution:
A John is walking to Sam's house at a constant rate.
B John gets to Sam's house and is waiting for the bus.
C John and Sam are riding the bus to school. The bus is moving at a constant rate, faster than John's walking rate.
D The bus stops.
E The bus resumes at the same rate as in part C.

Example 2:
Describe the graph of the function between $x = 2$ and $x = 5$?

Solution:
The graph is non-linear and decreasing.

Geometry	8.G.

College and Career Readiness Cluster

Understand congruence and similarity using physical models, transparencies, or geometry software.
Understand and apply the Pythagorean Theorem.
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

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: **translations, rotations, reflections, line of reflection, center of rotation, clockwise, counterclockwise, parallel lines, congruence, ≅, reading A' as "A prime", similarity, dilations, pre-image, image, rigid transformations, exterior angles, interior angles, alternate interior angles, angle-angle criterion, deductive reasoning, vertical angles, adjacent, supplementary, complementary, corresponding, scale factor, transversal, parallel**

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: **right triangle, hypotenuse, legs, Pythagorean Theorem, Pythagorean triple**

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: **cones, cylinders, spheres, radius, volume, height, Pi**

Enduring Understandings:

Understand congruence and similarity using models or software.
Understand and apply the Pythagorean Theorem.
Solve real-world mathematical problems involving volume of cylinders, cones, and spheres.

Essential Questions:
What are the properties of rotations, reflections, translations, and dilations?

How can congruency or similarity between two figures be described by a series of rotations, reflections, translations, and dilations?
What are the relationships between interior and exterior sums of triangles?
What are the relationships between angles when parallel lines are cut by a transversal?
What is the Pythagorean Theorem used for in real world application and in the coordinate plane?
How can the formulas for the volume of cones, cylinders, and spheres be derived and used to solve real-world problems?

| College and Career Readiness Standards *Students are expected to:*	Mathematical Practices	Unpacking Explanations and Examples *What does this standard mean that a student will know and be able to do?*
8.G.A.1 <mark>Verify</mark> experimentally the properties of <mark>rotations, reflections, and translations:</mark> a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines.	8.MP.4. Model with mathematics. 8.MP.5. Use appropriate tools strategically. 8.MP.6. Attend to precision. 8.MP.7. Look for and make use of structure. 8.MP.8. Look for and express regularity in repeated reasoning.	Students need multiple opportunities to explore the transformation of figures so that they can appreciate that points stay the same distance apart and lines stay at the same angle after they have been rotated, reflected, and/or translated. Students are not expected to work formally with properties of dilations until high school.
8.G.A.2. <mark>Understand</mark> that a two-dimensional figure is congruent	8.MP.2. Reason abstractly and quantitatively.	**Example 1:** Is Figure A congruent to Figure A'? Explain how you know.

Fig A

Solution:
These figures are congruent since A' was produced by translating each vertex of Figure A 3 to the right and 1 down.

Example 2:

Describe the sequence of transformations that results in the transformation of Figure A to Figure A'.

Solution:
 Figure A' was produced by a 90º clockwise rotation around the origin.

to another if the second can be obtained from the first by a sequence of <mark>rotations, reflections, and translations;</mark> given two congruent figures, describe a sequence that exhibits the congruence between them.	8.MP.4. Model with mathematics. 8.MP.6. Attend to precision. 8.MP.7. Look for and make use of structure.	(see above)
8.G.A.3 <mark>Describe</mark> the effect of <mark>dilations, translations, rotations, and</mark>	8.MP.3. Construct viable arguments and critique the reasoning of others.	**Dilations** A dilation is a non-rigid transformation that moves each point along a ray which starts from a fixed center, and multiplies distances from this center by a common scale factor. Dilations enlarge (scale factors greater than one) or reduce (scale factors less than one) the size of a figure by the scale factor. In 8th grade, dilations will be from the origin. The dilated figure is *similar* to its pre-image.

reflections on two-dimensional figures using coordinates.	8.MP.4. Model with mathematics. 8.MP.5. Use appropriate tools strategically. 8.MP.6. Attend to precision. 8.MP.7. Look for and make use of structure.	The coordinates of A are (2, 6); A' (1, 3). The coordinates of B are (6, 4) and B' are (3, 2). The coordinates of C are (4, 0) and C' are (2, 0). Each of the image coordinates is ½ the value of the pre-image coordinates indicating a scale factor of ½. The scale factor would also be evident in the length of the line segments using the ratio: $\frac{\text{image length}}{\text{pre-image length}}$
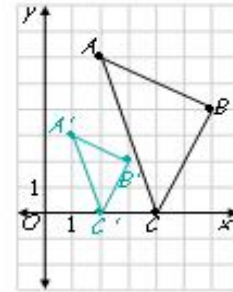
Translation: A translation is a transformation of an object that moves the object so that every point of the object moves in the same direction as well as the same distance. In a translation, the translated object is *congruent* to its pre-image.

$\triangle ABC$ has been translated 7 units to the right and 3 units up. To get from A (1,5) to A' (8,8), move A 7 units to the right (from $x = 1$ to $x = 8$) and 3 units up (from $y = 5$ to $y = 8$). Points B + C also move in the same direction (7 units to the right and 3 units up).
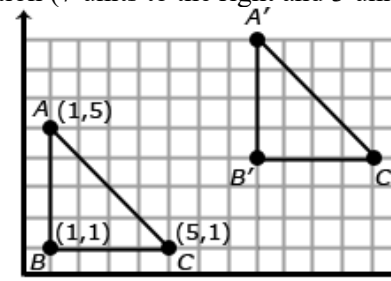
Reflection: A reflection is a transformation that flips an object across a line of reflection (in a coordinate grid the line of reflection may be the x or y axis). In a rotation, the rotated object is *congruent* to its pre-image.
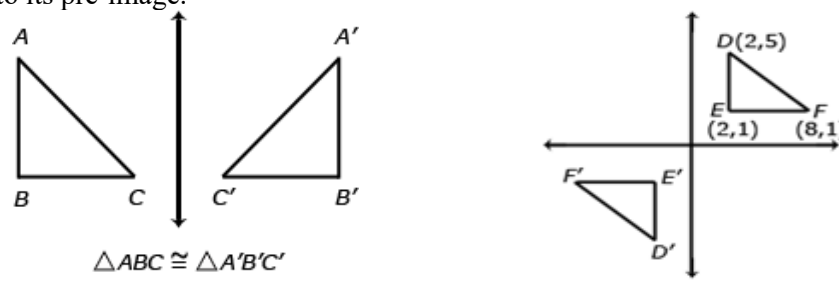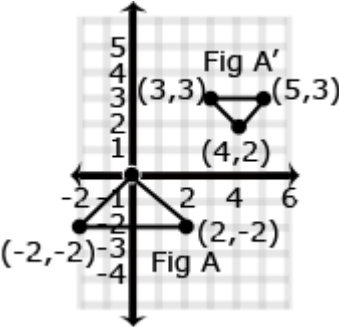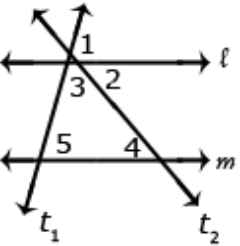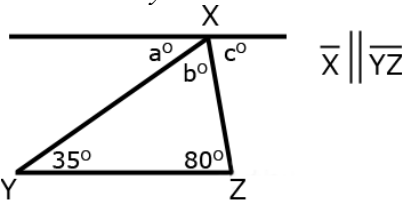
When an object is reflected across the y axis, the reflected x coordinate is the opposite of the pre-image x coordinate.
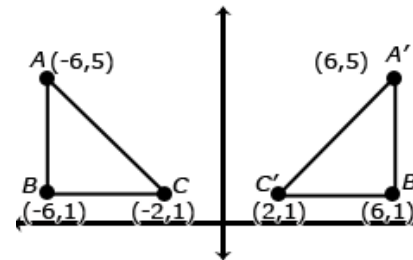
Rotation: A rotated figure is a figure that has been turned about a fixed point. This is called the center of rotation. A figure can be rotated up to 360˚. Rotated figures are *congruent* to their pre-image figures.

		Consider when $\triangle DEF$ is rotated 180° clockwise about the origin. The coordinates of $\triangle DEF$ are D (2,5), E(2,1), and F(8,1). When rotated 180°, $\triangle D'E'F'$ has new coordinates D' (-2,-5), E'(-2,-1) and F'(-8,-1). Each coordinate is the opposite of its pre-image.
8.G.A.4 <mark>Understand</mark> that a two-dimensional figure is similar to another if the second can be obtained from the first by a <mark>sequence of rotations, reflections, translations, and dilations;</mark> given two similar two-dimensional figures, <mark>describe</mark> a sequence that exhibits the similarity between them.	8.MP.2. Reason abstractly and quantitatively. 8.MP.4. Model with mathematics. 8.MP.5. Use appropriate tools strategically. 8.MP.6. Attend to precision. 8.MP.7. Look for and make use of structure.	**Example 1:** Is Figure A similar to Figure A'? Explain how you know. **Solution:** Dilated with a scale factor of ½ then reflected across the *x*-axis, making Figures A and A' similar.

Example 2:
Describe the sequence of transformations that results in the transformation of Figure A to Figure A'.

*Solution***:**
 90° clockwise rotation, translate 4 right and 2 up, dilation of ½. In this case, the scale factor of the dilation can be found by using the horizontal distances on the triangle (image = 2 units; pre-image = 4 units)

8.G.A.5 Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange	8.MP.3. Construct viable arguments and critique the reasoning of others. 8.MP.4. Model with mathematics. 8.MP.5. Use appropriate tools strategically. 8.MP.6. Attend to precision.	Students can informally prove relationships with transversals. **Example 1**: Show that m $\angle 3$ + m $\angle 4$ + m $\angle 5$ = 180° if l and *m* are parallel lines and t_1 & t_2 are transversals. *Solution:* $\angle 1$ + $\angle 2$ + $\angle 3$ = 180°. Angle 1 and Angle 5 are congruent because they are corresponding angles ($\angle 5 \cong \angle 1$). $\angle 1$ can be substituted for $\angle 5$. $\angle 4 \cong \angle 2$ because alternate interior angles are congruent. $\angle 4$ can be substituted for $\angle 2$. Therefore $m \angle 3$ + $m \angle 4$ + $m \angle 5$ = 180°

three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.	8.MP.7. Look for and make use of structure.	Students can informally conclude that the sum of a triangle is 180° (the angle-sum theorem) by applying their understanding of lines and alternate interior angles. **Example 2**: In the figure below, line x is parallel to line *yz*: Angle *a* is 35° because it alternates with the angle inside the triangle that measures 35°. Angle *c* is 80° because it alternates with the angle inside the triangle that measures 80°. Because lines have a measure of 180°, and angles *a* + *b* + *c* form a straight line, then angle *b* must be 65° (180 − 35 + 80 = 65). Therefore, the sum of the angles of the triangle are 35° + 65° + 80°.
8.G.B.6 <mark>Explain</mark> a proof of the <mark>Pythagorean Theorem</mark> and its converse.	*8.MP.3*. Construct viable arguments and critique the reasoning of others. *8.MP.4*. Model with mathematics. *8.MP.6*. Attend to precision. *8.MP.7*. Look for and make use of structure.	Using models, students explain the Pythagorean Theorem, understanding that the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle. Students also understand that given three side lengths with this relationship forms a right triangle. **Example 1:** The distance from Jonestown to Maryville is 180 miles, the distance from Maryville to Elm City is 300 miles, and the distance from Elm City to Jonestown is 240 miles. Do the three towns form a right triangle? Why or why not? *Solution*: If these three towns form a right triangle, then 300 would be the hypotenuse since it is the greatest distance. $180^2 + 240^2 = 300^2$ $32400 + 57600 = 90000$ $90000 = 90000$ These three towns form a right triangle.

8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	*8.MP.1.* Make sense of problems and persevere in solving them. *8.MP.2.* Reason abstractly and quantitatively. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **Example:** The Irrational Club wants to build a tree house. They have a 9-foot ladder that must be propped diagonally against the tree. If the base of the ladder is 5 feet from the bottom of the tree, how high will the tree house be off the ground? *Solution*: $a^2 + 5^2 = 9^2$ $a^2 + 25 = 81$ $a^2 = 56$ $\sqrt{a^2} = \sqrt{56}$ $a = \sqrt{56}$ or ~7.5
8.G.B.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	*8.MP.1.* Make sense of problems and persevere in solving them. *8.MP.2.* Reason abstractly and quantitatively. *8.MP.4.* Model with mathematics.	One application of the Pythagorean Theorem is finding the distance between two points on the coordinate plane. Students build on work from 6th grade (finding vertical and horizontal distances on the coordinate plane) to determine the lengths of the legs of the right triangle drawn connecting the points. Students understand that the line segment between the two points is the length of the hypotenuse. NOTE: The use of the distance formula is not an expectation.

	8.MP.5. Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	**Example 1:** Find the length of $\overline{AB}$. *Solution:* 1. Form a right triangle so that the given line segment is the hypotenuse. 2. Use Pythagorean Theorem to find the distance (length) between the two points. $6^2 + 7^2 = c^2$ $36 + 49 = c^2$ $85 = c^2$ $\sqrt{85} = c$ **Example 2:** Find the distance between (-2, 4) and (-5, -6). ***Solution*:** The distance between -2 and -5 is the horizontal length; the distance between 4 and -6 is the vertical distance. Horizontal length: 3 Vertical length: 10 $10^2 + 3^2 = c^2$ $100 + 9 = c^2$ $109 = c^2$ $\sqrt{109} = \sqrt{c^2}$ $\sqrt{109} = c$ Students find area and perimeter of two-dimensional figures on the coordinate plane, finding the distance between each segment of the figure. (Limit one diagonal line, such as a right trapezoid or parallelogram)
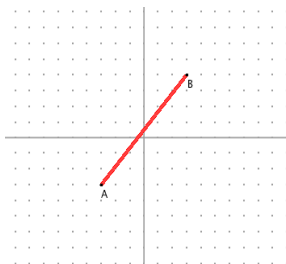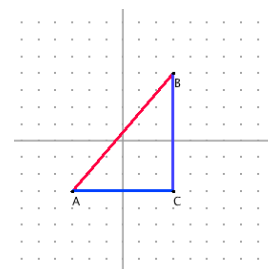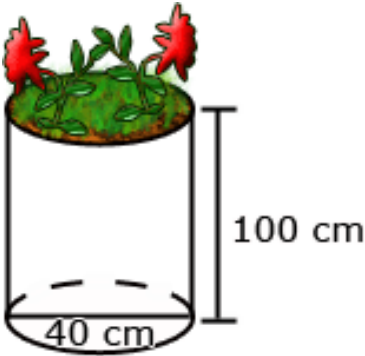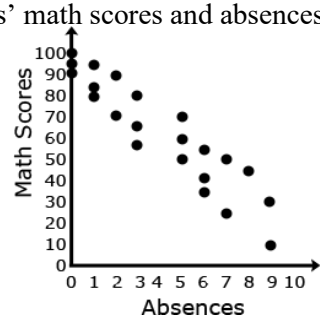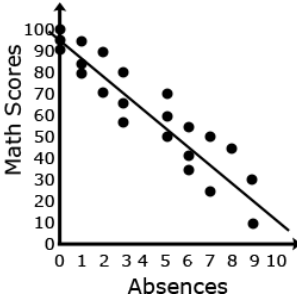
College and Career Readiness Cluster		
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.		
College and Career Readiness Standards *Students are expected to:*	**Mathematical Practices**	**Unpacking Explanations and Examples** *What does this standard mean that a student will know and be able to do?*
8.G.C.9. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.	*8.MP.1.* Make sense of problems and persevere in solving them. *8.MP.2.* Reason abstractly and quantitatively. *8.MP.3.* Construct viable arguments and critique the reasoning of others. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure. *8.MP.8.* Look for and express regularity in repeated reasoning.	<u>**Example**</u>: James wanted to plant pansies in his new planter. He wondered how much potting soil he should buy to fill it. Use the measurements in the diagram below to determine the planter's volume. 100 cm 40 cm cylindrical planter

Statistics and Probability		8.SP
College and Career Readiness Cluster		
Investigate patterns of association in bivariate data.		
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: **bivariate data, scatter plot, linear model, clustering, linear association, non-linear association, outliers, positive association, negative association, categorical data, two-way table, relative frequency**		
Enduring Understandings: Statistical tools can be used to Investigate patterns of association in bivariate data. (scatter plots) **Essential Questions:** How can scatter plots be constructed and used to interpret data? How is the line-of-best-fit used to assess data and solve real-world problems? How can a two-way table be constructed and interpreted?		

College and Career Readiness Standards *Students are expected to:*	Mathematical Practices	Unpacking Explanations and Examples *What does this standard mean that a student will know and be able to do?*
8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear	*8.MP.2.* Reason abstractly and quantitatively. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision.	Bivariate data refers to two-variable data, one to be graphed on the *x*-axis and the other on the *y*-axis. Students represent numerical data on a scatter plot, to examine relationships between variables. They analyze scatter plots to determine if the relationship is linear (positive, negative association or no association) or non-linear. Students can use tools such as those at the National Center for Educational Statistics to create a graph or generate data sets. (http://nces.ed.gov/nceskids/createagraph/default.aspx) Data can be expressed in years. In these situations it is helpful for the years to be "converted" to 0, 1, 2, etc. For example, the years of 1960, 1970, and 1980 could be represented as 0 (for 1960), 10 (for 1970) and 20 (for 1980).

association, and nonlinear association.	*8.MP.7.* Look for and make use of structure.	**Example 1:** Data for 10 students' Math and Science scores are provided in the chart. Describe the association between the Math and Science scores. **Solution:** This data has a positive association. **Example 2:** Data for 10 students' Math scores and the distance they live from school are provided in the table below. Describe the association between the Math scores and the distance they live from school. **Solution:** There is no association between the math score and the distance a student lives from school.
8.SP.A.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a	*8.MP.2.* Reason abstractly and quantitatively. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically.	The capacity of the fuel tank in a car is 13.5 gallons. The table below shows the number of miles traveled and how many gallons of gas have been used. Describe the relationship between the variables. If the data is linear, determine a line of best fit. Do you think the line represents a good fit for the data set? Why or why not? What is the average fuel efficiency of the car in miles per gallon?

Example 1 table:

Student	1	2	3	4	5	6	7	8	9	10
Math	64	50	85	34	56	24	72	63	42	93
Science	68	70	83	33	60	27	74	63	40	96

Example 2 table:

Student	1	2	3	4	5	6	7	8	9	10
Math	64	50	85	34	56	24	72	63	42	93
Distance from School (miles)	0.5	1.8	1	2.3	3.4	0.2	2.5	1.6	0.8	2.5

8.SP.A.2 table:

Miles Traveled	0	75	120	160	250	300
Gallons Used	0	2.3	4.5	5.7	9.7	10.7

straight line, and informally assess the model fit by judging the closeness of the data points to the line	*8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	
8.SP.A.3 <mark>Use</mark> the equation of a linear model to <mark>solve</mark> problems in the context of bivariate measurement data, <mark>interpret</mark>ing the <mark>slope and intercept.</mark>	*8.MP.2.* Reason abstractly and quantitatively. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	Linear models can be represented with a linear equation. Students interpret the slope and *y*-intercept of the line in the context of the problem. **Example 1:** 1. Given data from students' math scores and absences, make a scatterplot. | Absences	Math Scores
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3	65
5	50
1	95
1	85
3	80
6	34
5	70
3	56
0	100
7	24
8	45
2	71
9	30
0	95
6	55
6	42
2	90
0	92
5	60
7	50
9	10
1	80	

2. Draw a linear model paying attention to the closeness of the data points on either side of the line.

3. From the linear model, determine an approximate linear equation that models the given data (about $y = -\dfrac{25}{3} x + 95$)

4. Students should recognize that 95 represents the y-intercept and $-\dfrac{25}{3}$ represents the slope of the line. In the context of the problem, the y-intercept represents the math score a student with 0 absences could expect. The slope indicates that the math scores decreased 25 points for every 3 absences.

Students can use this linear model to solve problems. For example, through substitution, they can use the equation to determine that a student with 4 absences should expect to receive a math score of about 62. They can then compare this value to their line.

| 8.SP.A.4 ==Understand== that ==patterns of association== can also be seen in bivariate categorical data by displaying ==frequencies and relative frequencies in a two-way table.== ==Construct== and ==interpret== a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. | *8.MP.2.* Reason abstractly and quantitatively.

8.MP.3. Construct viable arguments and critique the reasoning of others.

8.MP.4. Model with mathematics.

8.MP.5. Use appropriate tools strategically.

8.MP.6. Attend to precision.

8.MP.7. Look for and make use of structure. | Students understand that a two-way table provides a way to organize data between two categorical variables. Data for both categories needs to be collected from each subject. Students calculate the relative frequencies to describe associations.

Example 1:
Twenty-five students were surveyed and asked if they received an allowance and if they did chores. The table below summarizes their responses.

<table><tr><td></td><td>Receive Allowance</td><td>No Allowance</td></tr><tr><td>Do Chores</td><td>15</td><td>5</td></tr><tr><td>Do Not Do Chores</td><td>3</td><td>2</td></tr></table>

Of the students who do chores, what percent do not receive an allowance?

Solution: 5 of the 20 students who do chores do not receive an allowance, which is 25% |