

# **Merrimack School District Mathematics Curriculum**

## **Grade 7 Standard Math**

### 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 7, students solve problems involving ratios and rates and discuss how they solved the problems. 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 7, students represent a wide variety of real world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. 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 7, 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.). The students 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 7, 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 explore covariance and represent two quantities simultaneously. They use measures of center and variability and data displays (i.e. box plots and histograms) to draw inferences, make comparisons and formulate predictions. Students use experiments or simulations to generate data sets and create probability models. 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 any problem’s 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 7 may decide to represent similar data sets using dot plots with the same scale to visually compare the center and variability of the data. Students might use physical objects or applets to generate probability data and use graphing calculators or spreadsheets to manage and represent data in different forms.
6. Attend to precision.	In grade 7, 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 define variables, specify units of measure, and label axes accurately. Students use appropriate terminology when referring to rates, ratios, probability models, geometric figures, data displays, and components of expressions, equations or inequalities.
7. Look for and make use of structure.	Students routinely seek patterns or structures to model and solve problems. For instance, students recognize patterns that exist in ratio tables making connections between the constant of proportionality in a table with the slope of a graph. Students apply properties to generate equivalent expressions (i.e. $6 + 2x = 3(2 + x)$ by distributive property) and solve equations (i.e. $2c + 3 = 15$ , $2c = 12$ by subtraction property of equality), $c = 6$ by division property of equality). Students compose and decompose two- and three-dimensional figures to solve real world problems involving scale drawings, surface area, and volume. Students examine tree diagrams or systematic lists to determine the sample space for compound events and verify that they have listed all possibilities.
8. Look for and express regularity in repeated reasoning.	In grade 7, students use repeated reasoning to understand algorithms and make generalizations about patterns. During multiple opportunities to solve and model problems, they may notice that $a/b \div c/d = ad/bc$ and construct other examples and models that confirm their generalization. They extend their thinking to include complex fractions and rational numbers. Students formally begin to make connections between covariance, rates, and representations showing the relationships between quantities. They create, explain, evaluate, and modify probability models to describe simple and compound events.

## Grade 7 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 seventh grade can be found in the *College and Career Readiness Standards for Mathematics*.

1. **Developing understanding of and applying proportional relationships**

Students extend their understanding of ratios and develop understanding of proportionality to solve single- and multi-step problems. Students use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships.

2. **Developing understanding of operations with rational numbers and working with expressions and linear equations**

Students develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.

3. **Solving problems involving scale drawings and informal geometric constructions, and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume**

Students continue their work with area from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity in Grade 8 they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms.

**4. Drawing inferences about populations based on samples**

Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

## Grade 7 Overview

### Ratios and Proportional Relationships

- Analyze proportional relationships and use them to solve real-world and mathematical problems.

### The Number System

- Apply and extend previous understandings of operations of operations with fractions to add, subtract, multiply, and divide rational numbers.

### Expressions and Equations

- Use properties of operations to generate equivalent expressions.
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

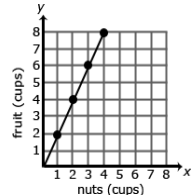
### Geometry

- Draw, construct and describe geometrical figures and describe the relationships between them.
- Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

### Statistics and Probability

- Use random sampling to draw inferences about a population.
- Draw informal comparative inferences about two populations.
- Investigate chance processes and develop, use, and evaluate probability models.

<b>Ratios and Proportional Relationships</b>		<b>7.RP</b>
<b>College and Career Readiness Cluster</b>		
<b>Analyze proportional relationships and use them to solve real-world and mathematical problems.</b>		
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: <b>unit rates, ratios, proportional relationships, proportions, constant of proportionality, complex fractions</b>		
<b>Enduring Understandings:</b> Real world mathematical problems can be solved by analyzing and using proportional relationships. <b>Essential Questions:</b> How can ratios and quantities be measured and expressed as unit rates? How can you identify and describe the properties of a proportional relationship? How can a proportional relationship be represented by an equation? How can proportional relationships be used to solve multi-step percent and ratio problems? How do we graph proportional relationships on the coordinate plane? What is the relationship between the slope of a line and its unit rate?		
<b>College and Career Readiness Standards</b> <i>Students are expected to:</i>	<b>Mathematical Practices</b>	<b>Unpacking Explanations and Examples</b> <i>What does this standard mean that a student will know and be able to do?</i>
<b>7.RP.A.1 Compute unit rates associated with ratios of fractions,</b> including ratios of lengths, areas and other quantities measured in like or different units. <i>For example, if a person walks 1/2</i>	7.MP.2. Reason abstractly and quantitatively.  7.MP.6. Attend to precision.	Students continue to work with unit rates from 6 <sup>th</sup> grade; however, the comparison now includes fractions compared to fractions. The comparison can be with like or different units. Fractions may be proper or improper.  <u><b>Example 1:</b></u>  <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"><math>\frac{1}{2}</math></div> <div style="text-align: center;"><math>\frac{1}{6}</math></div> </div>

<i>mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.</i>		<b>Solution:</b>  $\frac{1}{2}$ gal / $\frac{1}{6}$ wall.  3 gallons per 1 wall															
<b>7.RP.A.2.</b> <b>Recognize and represent</b> proportional relationships between quantities.  a. <b>Decide</b> whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.  b. <b>Identify</b> the constant of proportionality	<i>7.MP.1.</i> Make sense of problems and persevere in solving them.  <i>7.MP.2.</i> Reason abstractly and quantitatively.  <i>7.MP.3.</i> Construct viable arguments and critique the reasoning of others.  <i>7.MP.4.</i> Model with mathematics.  <i>7.MP.5.</i> Use appropriate tools strategically.  <i>7.MP.6.</i> Attend to precision.  <i>7.MP.7.</i> Look for and make use of structure.	<b>Examples:</b>  A student is making trail mix. <ul style="list-style-type: none"><li>• Create a graph to determine if the quantities of nuts and fruit are proportional for each serving size listed in the table. If the quantities are proportional, what is the constant of proportionality or unit rate that defines the relationship?</li><li>• Explain how you determined the constant of proportionality and how it relates to both the table and graph.</li></ul> <table border="1"><tr><td><b>Serving Size</b></td><td><b>1</b></td><td><b>2</b></td><td><b>3</b></td><td><b>4</b></td></tr><tr><td>Cups of Nuts (x)</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Cups of Fruit (y)</td><td>2</td><td>4</td><td>6</td><td>8</td></tr></table>   The relationship is proportional. For each of the other serving sizes there are 2 cups of fruit for every 1 cup of nuts (2:1).  The constant of proportionality is shown in the first column of the table and by the slope of the line on the graph.	<b>Serving Size</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	Cups of Nuts (x)	1	2	3	4	Cups of Fruit (y)	2	4	6	8
<b>Serving Size</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>													
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(unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

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

c. **Represent** proportional relationships by equations. *For example, if total cost  $t$  is proportional to the number  $n$  of items purchased at a constant price  $p$ , the relationship between the total cost and the number of items can be expressed as  $t = pn$ .*

d. **Explain** what a point  $(x, y)$  on the graph of a proportional relationship

- The graph below represents the cost of gum packs as a unit rate of \$2 dollars for every pack of gum. The unit rate is represented as \$2/pack. Represent the relationship using a table and an equation.

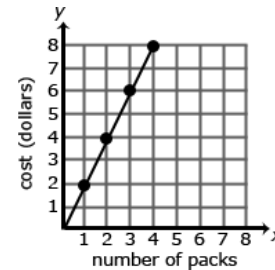


Table:

Number of Packs of Gum ( $g$ )	Cost in Dollars ( $d$ )
0	0
1	2
2	4
3	6
4	8

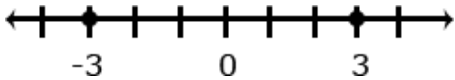
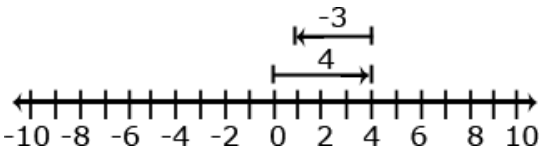
Equation:  $2g = d$ , where  $d$  is the cost in dollars and  $g$  is the packs of gum

A common error is to reverse the position of the variables when writing equations. Students may find it useful to use variables specifically related to the quantities rather than using  $x$  and  $y$ . Constructing verbal models can also be helpful. A student might describe the situation as “the number of packs of gum times the cost for each pack is the total cost in dollars”. They can use this verbal model to construct the equation. Students can check their equation by substituting values and comparing their results to the table. The checking process helps student revise and recheck their model as necessary. The number of packs of gum times the cost for each pack is the total cost ( $g \times 2 = d$ ).



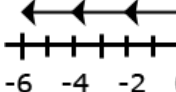
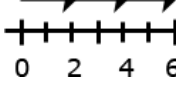


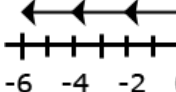
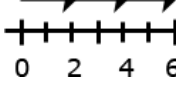


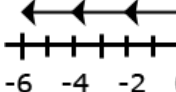
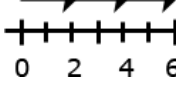
means in terms of the situation, with special attention to the points (0, 0) and (1, $r$ ) where $r$ is the unit rate.												
<b>7.RP.A.3. Use proportional relationships</b> to solve multistep ratio and percent problems. <i>Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.</i>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p>	<p>Students should be able to explain or show their work using a representation (numbers, words, pictures, physical objects, or equations) and verify that their answer is reasonable. For percent increase and decrease, students identify the starting value, determine the difference, and compare the difference in the two values to the starting value.</p> <p><b>Examples:</b></p> <ul style="list-style-type: none"><li>Gas prices are projected to increase 124% by April 2015. A gallon of gas currently costs \$4.17. What is the projected cost of a gallon of gas for April 2015?</li></ul> <p>A student might say: “The original cost of a gallon of gas is \$4.17. An increase of 100% means that the cost will double. I will also need to add another 24% to figure out the final projected cost of a gallon of gas. Since 25% \$4.17 is about \$1.04, the projected cost of a gallon of gas should be around \$9.40.”</p> <table><tr><td>100%</td><td>100%</td><td>24%</td></tr><tr><td>\$4.17</td><td>\$4.17</td><td>?</td></tr></table> <p><math>\\$4.17 + 4.17 + (0.24 \bullet 4.17) = 2.24 \times 4.17</math></p> <ul style="list-style-type: none"><li>A sweater is marked down 33%. Its original price was \$37.50. What is the price of the sweater before sales tax?</li></ul> <table><tr><td colspan="2">37.50</td></tr><tr><td>33% of 37.50</td><td>67% of 37.50</td></tr></table>	100%	100%	24%	\$4.17	\$4.17	?	37.50		33% of 37.50	67% of 37.50
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	7.MP.8. Look for and express regularity in repeated reasoning.	<p>The discount is 33% times 37.50. The sale price of the sweater is the original price minus the discount or 67% of the original price of the sweater, or Sale Price = 0.67 x Original Price.</p>				
		<p>• A shirt is on sale for 40% off. The sale price is \$12. What was the original price? What was the amount of the discount?</p>				
		<table><tr><td>Discount</td><td>Sale Price - \$12</td></tr><tr><td colspan="2">Original Price (p)</td></tr></table> <p>0.60p = 12</p>	Discount	Sale Price - \$12	Original Price (p)	
Discount	Sale Price - \$12					
Original Price (p)						
		<p>• At a certain store, 48 television sets were sold in April. The manager at the store wants to encourage the sales team to sell more TVs and is going to give all the sales team members a bonus if the number of TVs sold increases by 30% in May. How many TVs must the sales team sell in May to receive the bonus? Justify your solution.</p> <p>• A salesperson set a goal to earn \$2,000 in May. He receives a base salary of \$500 as well as a 10% commission for all sales. How much merchandise will he have to sell to meet his goal?</p> <p>• After eating at a restaurant, your bill before tax is \$52.60. The sales tax rate is 8%. You decide to leave a 20% tip for the waiter based on the pre-tax amount. How much is the tip you leave for the waiter? How much will the total bill be, including tax and tip? Express your solution as a multiple of the bill. The amount paid = 0.20 x \$52.50 + 0.08 x \$52.50 = 0.28 x \$52.50.</p>				

<b>The Number System</b>		<b>7.NS</b>
<b>College and Career Readiness Cluster</b>		
<b>Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.</b>		
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: <b>rational numbers, integers, additive inverse</b>		
<b>Enduring Understandings:</b> Number sense is developed through experience and can help determine effective and efficient strategies to solve problems/situations involving rational numbers.		
<b>Essential Questions:</b> How can we demonstrate the properties and processes of addition, subtraction, multiplication and division of rational numbers? How do we explain the conversion of a fraction to its equivalent decimal? How do we use division to distinguish between repeating and terminating decimals? How can the four operations with rational numbers be used to solve real world problems which may include complex fractions? How do we demonstrate understanding of fractions, terminating or repeating decimals, and percents as representations of rational numbers? How do we explain and interpret negative numbers in terms of everyday contexts, and the rules for adding, subtracting, multiplying, and dividing with integers (both positive and negative)?		
<b>College and Career Readiness Standards</b> <i>Students are expected to:</i>	<b>Mathematical Practices</b>	<b>Unpacking Explanations and Examples</b> <i>What does this standard mean that a student will know and be able to do?</i>
<b>7.NS.A.1</b> Apply and extend previous understandings of addition and	7.MP.2. Reason abstractly and quantitatively.	Visual representations may be helpful as students begin this work; they become less necessary as students become more fluent with the operations.

<p>subtraction to add and subtract <b>rational numbers</b>; represent addition and subtraction on a horizontal or vertical number line diagram.</p> <p>a. <b>Describe</b> situations in which opposite quantities combine to make 0. For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.</p> <p>b. <b>Understand</b> <math>p + q</math> as the number located a distance <math> q </math> from <math>p</math>, in the positive or negative direction depending on whether <math>q</math> is positive or negative. Show</p>	<p>7.MP.4. Model with mathematics.</p> <p>7.MP.7. Look for and make use of structure.</p>	<p><b>Examples:</b></p> <ul style="list-style-type: none"> <li>Use a number line to illustrate: <ul style="list-style-type: none"> <li><math>p - q</math></li> <li><math>p + (-q)</math></li> <li>If this equation is true: <math>p - q = p + (-q)</math></li> </ul> </li> <li>-3 and 3 are shown to be opposites on the number line because they are equal distance from zero and therefore have the same absolute value and the sum of the number and its opposite is zero.</li> </ul>  <ul style="list-style-type: none"> <li>You have \$4 and you need to pay a friend \$3. What will you have after paying your friend?</li> </ul> $4 + (-3) = 1 \text{ or } (-3) + 4 = 1$ 
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<p>that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.</p> <p>c. Understand subtraction of rational numbers as adding the additive inverse, <math>p - q = p + (-q)</math>. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.</p> <p>d. Apply properties of operations as strategies to add and subtract rational numbers.</p>		
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<p><b>7.NS.A.2</b> Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.</p> <p>a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as <math>(-1)(-1) = 1</math> and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-</p>	<p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.7. Look for and make use of structure.</p>	<p>Multiplication and division of integers is an extension of multiplication and division of whole numbers.</p> <p><u><b>Example:</b></u></p> <p>Examine the family of equations. What patterns do you see? Create a model and context for each of the products.</p> <table border="1" data-bbox="1016 553 1726 1248"> <thead> <tr> <th>Equation</th><th>Number Line Model</th><th>Context</th></tr> </thead> <tbody> <tr> <td><math>2 \times 3 = 6</math></td><td></td><td>Selling two posters at \$3.00 per poster</td></tr> <tr> <td><math>2 \times -3 = -6</math></td><td></td><td>Spending \$3.00 each on two posters</td></tr> <tr> <td><math>-2 \times 3 = -6</math></td><td></td><td>Owing \$2.00 to each of your three friends</td></tr> <tr> <td><math>-2 \times -3 = 6</math></td><td></td><td>Forgiving three debts of \$2.00 each</td></tr> </tbody> </table>	Equation	Number Line Model	Context	$2 \times 3 = 6$		Selling two posters at \$3.00 per poster	$2 \times -3 = -6$		Spending \$3.00 each on two posters	$-2 \times 3 = -6$		Owing \$2.00 to each of your three friends	$-2 \times -3 = 6$		Forgiving three debts of \$2.00 each
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<p>world contexts.</p> <p>b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If <math>p</math> and <math>q</math> are integers, then <math>-(p/q) = (-p)/q = p/(-q)</math>. Interpret quotients of rational numbers by describing real-world contexts.</p> <p>c. Apply properties of operations as strategies to multiply and divide rational numbers.</p> <p>d. Convert a rational number to a decimal using long division; know that the</p>		
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decimal form of a rational number terminates in 0s or eventually repeats.		
<p><b>7.NS.A.3 Solve real-world and mathematical problems involving the four operations with rational numbers.</b></p> <p>Computations with rational numbers extend the rules for manipulating fractions to complex fractions.</p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p>	<p><u><b>Examples:</b></u></p> <ul style="list-style-type: none"> <li>Your cell phone bill is automatically deducting \$32 from your bank account every month. How much will the deductions total for the year?</li> </ul> $-32 + -32 + -32 + -32 + -32 + -32 + -32 + -32 + -32 + -32 + -32 + -32 = 12 (-32)$ <ul style="list-style-type: none"> <li>It took a submarine 20 seconds to drop to 100 feet below sea level from the surface. What was the rate of the descent?</li> </ul>

<b>Expressions and Equations</b>		<b>7.EE</b>
<b>College and Career Readiness Cluster</b>		
<b>Use properties of operations to generate equivalent expressions.</b>		
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: <b>coefficients, like terms, distributive property, factor</b>		
<b>Enduring Understandings:</b> Real world problems can be represented and solved by quantifying and manipulating information.		
<b>Essential Questions:</b> How can we use the properties of operations to rewrite an expression to solve real world problems? How are equations and inequalities used for solving real world problems? How do we use variables in algebraic expressions to find solutions when problem solving?		
<b>College and Career Readiness Standards</b> <i>Students are expected to:</i>	<b>Mathematical Practices</b>	<b>Unpacking Explanations and Examples</b> <i>What does this standard mean that a student will know and be able to do?</i>
<b>7.EE.A.1</b> Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.	7.MP.2. Reason abstractly and quantitatively. 7.MP.6. Attend to precision. 7.MP.7. Look for and make use of structure.	<b>Examples:</b> <ul style="list-style-type: none"> <li>Write an equivalent expression for <math>3(x + 5) - 2</math>.</li> <li>Suzanne thinks the two expressions <math>2(3a - 2) + 4a</math> and <math>10a - 2</math> are equivalent? Is she correct? Explain why or why not?</li> <li>Write equivalent expressions for: <math>3a + 12</math>.</li> </ul> <b>Possible solutions:</b> It might include factoring as in $3(a + 4)$ , or other expressions such as $a + 2a + 7 + 5$ . <ul style="list-style-type: none"> <li>A rectangle is twice as long as wide. One way to write an expression to find the perimeter would be <math>w + w + 2w + 2w</math>. Write the expression in two other ways.</li> </ul>

		<p><b>Solution:</b>  <math>6w</math> OR <math>2(w) + 2(2w)</math>.</p>  <p>• An equilateral triangle has a perimeter of <math>6x + 15</math>. What is the length of each of the sides of the triangle?</p> <p><b>Solution:</b>  <math>3(2x + 5)</math>, therefore each side is <math>2x + 5</math> units long.</p>
<p><b>7.EE.A.2</b>  Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. For example, <math>a + 0.05a = 1.05a</math> means that “increase by 5%” is the same as “multiply by 1.05.”</p>	<p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p> <p>7.MP.8. Look for and express regularity in repeated reasoning.</p>	<p>Students understand the reason for rewriting an expression in terms of a contextual situation. For example, students understand that a 20% discount is the same as finding 80% of the cost, <math>c</math> (<math>0.80c</math>).</p> <p><b>Example 1:</b>  All varieties of a certain brand of cookies are \$3.50. A person buys peanut butter cookies and chocolate chip cookies. Write an expression that represents the total cost, <math>T</math>, of the cookies if <math>p</math> represents the number of peanut butter cookies and <math>c</math> represents the number of chocolate chip cookie</p> <p><b>Solution:</b>  Students could find the cost of each variety of cookies and then add to find the total. <math>T = 3.50p + 3.50c</math> Or students could recognize that multiplying 3.50 by the total number of boxes (regardless of variety) will give the same total. <math>T = 3.50(p + c)</math></p>
<p><b>7.EE.B.3</b> Solve multi-step real-life and mathematical problems posed with</p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p>	<p>Students solve contextual problems and mathematical problems using rational numbers. Students convert between fractions, decimals, and percents as needed to solve the problem. Students use estimation to justify the reasonableness of answers.</p>

<p>positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. <b>Apply properties of operations</b> to calculate with numbers in any form; <b>convert</b> between forms as appropriate; and <b>assess</b> the reasonableness of answers using mental computation and estimation strategies. <i>For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar 9 3/4 inches long in the</i></p>	<p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p> <p>7.MP.8. Look for and express regularity in repeated reasoning.</p>	<p>Estimation strategies for calculations with fractions and decimals extend from students' work with whole number operations. Estimation strategies include, but are not limited to:</p> <ul style="list-style-type: none"> <li>* front-end estimation with adjusting (using the highest place value and estimating from the front end making adjustments to the estimate by taking into account the remaining amounts)</li> <li>* clustering around an average (when the values are close together an average value is selected and multiplied by the number of values to determine an estimate)</li> <li>* rounding and adjusting (students round down or round up and then adjust their estimate depending on how much the rounding affected the original values)</li> <li>* using friendly or compatible numbers such as factors (students seek to fit numbers together - i.e., rounding to factors and grouping numbers together that have round sums like 100 or 1000)</li> <li>* using benchmark numbers that are easy to compute (students select close whole numbers for fractions or decimals to determine an estimate)</li> </ul>
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<p>center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.</p>								
<p><b>7.EE.B.4.</b> Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p> <p>a. Solve word problems leading to equations of the form <math>px+q=r</math> and <math>p(x+q)=r</math>, where <math>p</math>, <math>q</math>, and <math>r</math> are specific rational numbers. Solve equations of these</p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p>	<p>Students write an equation or inequality to model the situation. Students explain how they determined whether to write an equation or inequality and the properties of the real number system that you used to find a solution. In contextual problems, students define the variable and use appropriate units.</p> <p><b>Example 1:</b> The youth group is going on a trip to the state fair. The trip costs \$52. Included in that price is \$11 for a concert ticket and the cost of 2 passes, one for the rides and one for the game booths. Each of the passes cost the same price. Write an equation representing the cost of the trip and determine the price of pass.</p> <p><b>Solution:</b> <math>x</math> = cost of one pass</p> <table border="1" data-bbox="930 1196 1497 1317"> <tr> <td><math>x</math></td><td><math>x</math></td><td>11</td></tr> <tr> <td colspan="3">52</td></tr> </table> <div data-bbox="1598 1200 1734 1289"> <math display="block">2x + 11 = 52</math> <math display="block">2x = 41</math> <math display="block">x = \\$20.50</math> </div>	$x$	$x$	11	52		
$x$	$x$	11						
52								

<p>forms fluently. <b>Compare</b> an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. <i>For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?</i></p> <p>b. <b>Solve</b> word problems leading to inequalities of the form <math>px + q &gt; r</math> or <math>px + q &lt; r</math>, where <math>p</math>, <math>q</math>, and <math>r</math> are specific rational numbers. <b>Graph</b> the solution set of the inequality and <b>interpret</b> it in the context of the problem. <i>For example: As a</i></p>	<p>7.MP.7. Look for and make use of structure.</p> <p>7.MP.8. Look for and express regularity in repeated reasoning.</p>	<p><b>Example 2:</b>  Florencia has at most \$60 to spend on clothes. She wants to buy a pair of jeans for \$22 dollars and spend the rest on t-shirts. Each t-shirt costs \$8. Write an inequality for the number of t-shirts she can purchase.</p> <p><b>Solution:</b>  <math>x</math> = cost of one t-shirt  <math>8x + 22 \leq 60</math>  <math>x = 4.75</math>  4 is the most t-shirts she can purchase.</p> <p><b>Example 3:</b>  Steven has \$25 dollars to spend. He spent \$10.81, including tax, to buy a new DVD. He needs to save \$10.00 but he wants to buy a snack. If peanuts cost \$0.38 per package including tax, what is the maximum number of packages that Steven can buy?</p> <p><b>Solution:</b>  <math>x</math> = number of packages of peanuts  <math>25 \geq 10.81 + 10.00 + 0.38x</math>  <math>x = 11.03</math>  Steven can buy 11 packages of peanuts.  <math>2x = 41</math>  <math>x = \\$20.50</math></p>
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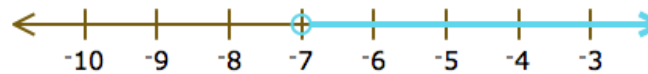
*salesperson, you are paid \$50 per week plus \$3 per sale. This week you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.*

**Example 4:**

Solve  $-0.5x - 5 < -1.5$  and graph the solution on a number line.

***Solution:***


$$x > -7$$

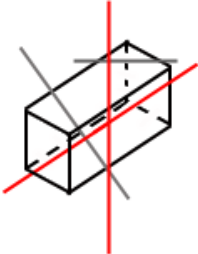


<b>Geometry</b>		<b>7.G</b>
<b>College and Career Readiness Cluster</b>		
<b>Draw, construct, and describe geometrical figures and describe the relationships between them.</b>		
Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: <b>scale drawing, dimensions, scale factor, plane sections, right rectangular prism, right rectangular pyramids, parallel, perpendicular, scalene triangle, obtuse triangle, equilateral triangle, right triangle</b>		
<b>Enduring Understandings:</b> Everyday objects have a variety of attributes and can be measured, described, combined, decomposed, or constructed in many ways.		
<b>Essential Questions:</b> How do we draw and describe scale drawings to assist in problem solving? How do we describe the two-dimensional figures that can be formed by slicing a three-dimensional figure? How can understanding the formulas for area and circumference of a circle be used to solve problems? How can the properties of angles be used to solve multi-step problems? How can area, surface area, and volume be used to solve problems?		
<b>College and Career Readiness Standards</b> <i>Students are expected to:</i>	<b>Mathematical Practices</b>	<b>Unpacking Explanations and Examples</b> <i>What does this standard mean that a student will know and be able to do?</i>
<b>7.G.A.1. Solve</b> problems involving scale drawings of <b>geometric figures</b> , such as computing actual lengths and areas from a <b>scale drawing</b> and reproducing a scale	<b>7.MP.1.</b> Make sense of problems and persevere in solving them.  <b>7.MP.2.</b> Reason abstractly and quantitatively.  <b>7.MP.3.</b> Construct viable arguments and	Students determine the dimensions of figures when given a scale and identify the impact of a scale on actual length (one-dimension) and area (two-dimensions). Students identify the scale factor given two figures. Using a given scale drawing, students reproduce the drawing at a different scale. Students understand that the lengths will change by a factor equal to the 7.G.2 Students draw geometric shapes with given parameters. Parameters could include parallel lines, angles, perpendicular lines, line segments, etc.  <b>Example 1:</b> Draw a quadrilateral with one set of parallel sides and no right angles. Students understand the characteristics of angles and side lengths that create a unique triangle, more than one triangle or no triangle.

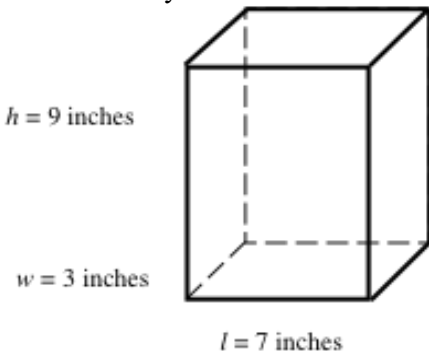


<p>drawing at a different scale.</p>	<p>critique the reasoning of others.</p> <p><i>7.MP.4.</i> Model with mathematics.</p> <p><i>7.MP.5.</i> Use appropriate tools strategically.</p> <p><i>7.MP.6.</i> Attend to precision.</p> <p><i>7.MP.7.</i> Look for and make use of structure.</p> <p><i>7.MP.8.</i> Look for and express regularity in repeated reasoning.</p>	<p><b><u>Example 2:</u></b> Can a triangle have more than one obtuse angle? Explain your reasoning.</p> <p><b><u>Example 3:</u></b> Will three sides of any length create a triangle? Explain how you know which will work. Possibilities to examine are:</p> <ul style="list-style-type: none"> <li>a. 13 cm, 5 cm, and 6 cm</li> <li>b. 3 cm, 3cm, and 3 cm</li> <li>c. 2 cm, 7 cm, 6 cm.</li> </ul> <p><b><u>Solution:</u></b> “A” above will not work; “B” and “C” will work. Students recognize that the sum of the two smaller sides must be larger than the third side.</p> <p><b><u>Example 4:</u></b> Julie showed you the scale drawing of her room. If each 2 cm on the scale drawing equals 5 ft., what are the actual dimensions of Julie’s room? Reproduce the drawing at 3 times its current size.</p> <div data-bbox="1037 943 1507 1187" data-label="Diagram"> </div>
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<p><b>7.G.A.2. Draw</b> (freehand, with ruler and protractor, and with technology) <b>geometric shapes with given conditions.</b> Focus on <b>constructing</b> triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.</p>	<p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p> <p>7.MP.8. Look for and express regularity in repeated reasoning.</p>	<p><b>Examples:</b></p> <ul style="list-style-type: none"> <li>Is it possible to draw a triangle with a <math>90^\circ</math> angle and one leg that is 4 inches long and one leg that is 3 inches long? If so, draw one. Is there more than one such triangle?</li> <li>Draw a triangle with angles that are 60 degrees. Is this a unique triangle? Why or why not?</li> <li>Draw an isosceles triangle with only one 80 degree angle. Is this the only possibility or can you draw another triangle that will also meet these conditions?</li> </ul> <div style="text-align: center;">  </div> <ul style="list-style-type: none"> <li>Can you draw a triangle with sides that are 13 cm, 5 cm and 6cm?</li> <li>Draw a quadrilateral with one set of parallel sides and no right angles.</li> </ul>
<p><b>7.G.A.3. Describe</b> the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.</p>	<p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.7. Look for and make use of structure.</p>	<p>Students need to describe the resulting face shape from cuts made parallel and perpendicular to the bases of right rectangular prisms and pyramids.</p> <p>Cuts made parallel will take the shape of the base; cuts made perpendicular will take the shape of the lateral (side) face.</p> <p>Cuts made at an angle through the right rectangular prism will produce a parallelogram.</p>

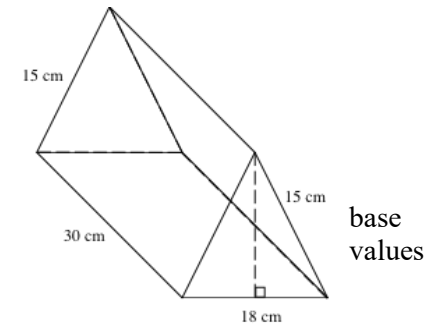
		<p><b>Example:</b></p> <ul style="list-style-type: none"> <li>Using a clay model of a rectangular prism, describe the shapes that are created when planar cuts are made diagonally, perpendicularly, and parallel to the base.</li> </ul> 
<p><b>7.G.B.4.</b> Know the formulas for the area and circumference of a circle and solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p>	<p>Students understand the relationship between radius and diameter. Students also understand the ratio of circumference to diameter can be expressed as pi. Building on these understandings, students generate the formulas for circumference and area. The illustration shows the relationship between the circumference and area. If a circle is cut into wedges and laid out as shown, a parallelogram results. Half of an end wedge can be moved to the other end a rectangle results. The height of the rectangle is the same as the radius of the circle. The base length is the circumference (<math>2\pi r</math>). The area of the rectangle (and therefore the circle) is found by the following calculations:</p> <p><b>Example 1:</b></p> <p>The seventh grade class is building a mini-golf game for the school carnival. The end of the putting green will be a circle. If the circle is 10 feet in diameter, how many square feet of grass carpet will they need to buy to cover the circle? How might someone communicate this information to the salesperson to make sure he receives a piece of carpet that is the correct size? Use 3.14 for pi.</p> <p><b>Solution:</b></p> $\text{Area} = \pi r^2$ $\text{Area} = 3.14 (5)^2$ $\text{Area} = 78.5 \text{ ft}^2$ <p>To communicate this information, ask for a 9 ft. by 9 ft. square of carpet.</p>

	<p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p> <p>7.MP.8. Look for and express regularity in repeated reasoning.</p>	<p><b>Example 2:</b> If a circle is cut from a square piece of plywood, how much plywood would be left over?</p> <p><b>Solution:</b> The area of the square is <math>28 \times 28</math> or <math>784 \text{ in}^2</math>. The diameter of the circle is equal to the length of the side of the square, or <math>28''</math>, so the radius would be <math>14''</math>. The area of the circle would be approximately <math>615.44 \text{ in}^2</math>. The difference in the amounts (plywood left over) would be <math>168.56 \text{ in}^2</math> (<math>784 - 615.44</math>).</p>
<p><b>7.G.B.5.</b> Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.</p>	<p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p>	<p>Students use understandings of angles and deductive reasoning to write and solve equations</p> <p><b>Example 1:</b> Write and solve an equation to find the measure of angle <math>x</math>.</p> <div data-bbox="1087 711 1444 873" data-label="Image"> </div> <p><b>Solution:</b> Find the measure of the missing angle inside the triangle (<math>180 - (90 + 50)</math>). The measure of angle <math>x</math> is supplementary to <math>50^\circ</math>, so subtract 50 from 180 to get a measure of <math>130^\circ</math> for <math>x</math>.</p> <p><b>Example 2:</b> Find the measure of angle <math>x</math>.</p> <div data-bbox="1201 1101 1411 1224" data-label="Image"> </div> <p><b>Solution:</b> <math>x = 120^\circ</math> since they are vertical angles or opposite angles, they have the same degree measure.</p>

<p><b>7.G.B.6.</b> <b>Solve</b> real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p> <p>7.MP.8. Look for and express regularity in repeated reasoning.</p>	<p>Students continue work from 5th and 6th grade to work with area, volume and surface area of two-dimensional and three-dimensional objects. (composite shapes)</p> <p><b>Example 1:</b> Huong covered the box to the right with sticky-backed decorating paper. The paper costs \$0.03 per square inch. How much money will Huong need to spend on paper?</p> <div></div> <p><b>Solution:</b> The surface area can be found by using the dimensions of each face to find the area and multiplying by 2:</p> <table><tr><td>Front:</td><td>7 in. x 9 in.</td><td>=</td><td>63 in<sup>2</sup> x 2 = 126 in<sup>2</sup></td></tr><tr><td>Top:</td><td>3 in. x 7 in.</td><td>=</td><td>21 in<sup>2</sup> x 2 = 42 in<sup>2</sup></td></tr><tr><td>Side:</td><td>3 in. x 9 in.</td><td>=</td><td>27 in<sup>2</sup> x 2 = 54 in<sup>2</sup></td></tr></table> <p>The surface area is the sum of these areas, or 222 in<sup>2</sup>. If each square inch of paper cost \$0.03, the cost would be \$6.66.</p>	Front:	7 in. x 9 in.	=	63 in <sup>2</sup> x 2 = 126 in <sup>2</sup>	Top:	3 in. x 7 in.	=	21 in <sup>2</sup> x 2 = 42 in <sup>2</sup>	Side:	3 in. x 9 in.	=	27 in <sup>2</sup> x 2 = 54 in <sup>2</sup>
Front:	7 in. x 9 in.	=	63 in <sup>2</sup> x 2 = 126 in <sup>2</sup>											
Top:	3 in. x 7 in.	=	21 in <sup>2</sup> x 2 = 42 in <sup>2</sup>											
Side:	3 in. x 9 in.	=	27 in <sup>2</sup> x 2 = 54 in <sup>2</sup>											

**Example 2:**

Jennie purchased a box of crackers from the deli. The box is in the shape of a triangular prism (see diagram below). If the volume of the box is 3,240 cubic centimeters, what is the height of the triangular face of the box? How much packaging material was used to construct the cracker box? Explain how you got your answer.

**Solution:**

Volume can be calculated by multiplying the area of the (triangle) by the height of the prism. Substitute given and solve for the area of the triangle

$$V = Bh$$

$$3,240 \text{ cm}^3 = B (30\text{cm})$$

$$\frac{3,240 \text{ cm}^3}{30 \text{ cm}} = \frac{B(30\text{cm})}{30 \text{ cm}}$$

$$108 \text{ cm}^2 = B (\text{area of the triangle})$$

To find the height of the triangle, use the area formula for the triangle, substituting the known values in the formula and solving for height. The height of the triangle is 12 cm.

The problem also asks for the surface area of the package. Find the area of each face and add:

$$2 \text{ triangular bases: } \frac{1}{2} (18 \text{ cm})(12 \text{ cm}) = 108 \text{ cm}^2 \times 2 = 216 \text{ cm}^2$$

$$2 \text{ rectangular faces: } 15 \text{ cm} \times 30 \text{ cm} = 450 \text{ cm}^2 \times 2 = 900 \text{ cm}^2$$

$$1 \text{ rectangular face: } 18 \text{ cm} \times 30 \text{ cm} = 540 \text{ cm}^2$$

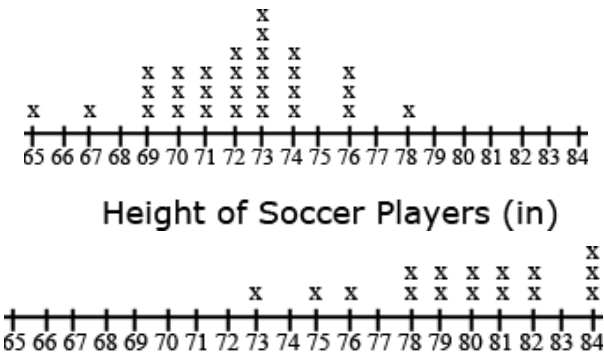
$$\text{Adding } 216 \text{ cm}^2 + 900 \text{ cm}^2 + 540 \text{ cm}^2 \text{ gives a total surface area of } 1656 \text{ cm}^2.$$

<b>Statistics and Probability</b>		<b>7.SP</b>
<b>College and Career Readiness Cluster</b>		
<b>Use random sampling to draw inferences about a population.</b>		
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: <b>random sampling, population, representative sample, inferences</b>		
<b>Enduring Understandings:</b> Reading, understanding, interpreting and communicating data are critical in modeling and generalizing in a variety of real world situations: drawing appropriate inferences, making informed conclusions and justifying decisions.		
<b>Essential Questions:</b> How can random sampling be used to gain and generalize information about a population? How does generating multiple random samples assist in drawing inferences about a population? How can data distributions and the measures of center and variability be used to compare two populations? How can probability be used to approximate the frequency of a chance event or make predictions about uncertain events? How can the probability of particular outcomes of a compound event be visually represented? How does probability quantify the likelihood that something will happen and enable us to make predictions and informed decisions?		
<b>College and Career Readiness Standards</b> <i>Students are expected to:</i>	<b>Mathematical Practices</b>	<b>Unpacking Explanations and Examples</b> <i>What does this standard mean that a student will know and be able to do?</i>
<b>7.SP.A.1.</b> Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population	7.MP.3. Construct viable arguments and critique the reasoning of others.  7.MP.6. Attend to precision.	Students recognize that it is difficult to gather statistics on an entire population. Instead a random sample can be representative of the total population and will generate valid predictions. Students use this information to draw inferences from data. A random sample must be used in conjunction with the population to get accuracy. For example, a random sample of elementary students cannot be used to give a survey about the prom.  <u><b>Example 1:</b></u> The school food service wants to increase the number of students who eat hot lunch in the cafeteria. The student council has been asked to conduct a survey of the student body to determine the students' preferences for hot lunch. They have determined three ways to do the

from a sample are valid only if the sample is representative of that population. <b>Understand</b> that random sampling tends to produce representative samples and support valid inferences.		survey. The three methods are listed below. Determine if each survey option would produce a random sample. Which survey option should the student council use and why?  1. Write all of the students' names on cards and pull them out in a draw to determine who will complete the survey.  2. Survey the first 20 students that enter the lunchroom.  3. Survey every 3rd student who gets off a bus.  <b>Solution:</b> Number 1. Accept all reasonable answers.															
<b>7.SP.A.2.</b> Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. <b>Generate</b> multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. <i>For example, estimate the mean word length in a book by randomly sampling</i>	<i>7.MP.1.</i> Make sense of problems and persevere in solving them.  <i>7.MP.2.</i> Reason abstractly and quantitatively.  <i>7.MP.3.</i> Construct viable arguments and critique the reasoning of others.  <i>7.MP.5.</i> Use appropriate tools strategically.  <i>7.MP.6.</i> Attend to precision.	Students collect and use multiple samples of data to make generalizations about a population. Issues of variation in the samples should be addressed.  <b>Example 1:</b> Below is the data collected from two random samples of 100 students regarding student's school lunch preferences. Make at least two inferences based on the results.  <div>Lunch Preferences</div> <table><tr><td>student sample</td><td>hamburgers</td><td>tacos</td><td>pizza</td><td>total</td></tr><tr><td>#1</td><td>12</td><td>14</td><td>74</td><td>100</td></tr><tr><td>#2</td><td>12</td><td>11</td><td>77</td><td>100</td></tr></table> <b>Solution:</b> Most students prefer pizza. More people prefer pizza and hamburgers and tacos combined. Accept any reasonable inference.	student sample	hamburgers	tacos	pizza	total	#1	12	14	74	100	#2	12	11	77	100
student sample	hamburgers	tacos	pizza	total													
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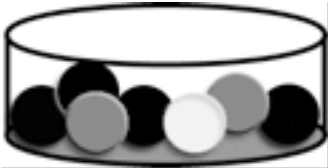
<p><i>words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.</i></p>	<p>7.MP.7. Look for and make use of structure.</p>	
<p><b>7.SP.B.3.</b> Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. <i>For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability</i></p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p>	<p>This is the students' first experience with comparing two data sets. Students build on their understanding of graphs, mean, median, Mean Absolute Deviation (MAD) and interquartile range from 6th grade.</p> <p>Students understand that:</p> <ol style="list-style-type: none"> <li>1. Assessing the data requires considering the measures of variability, as well as mean or median.</li> <li>2. Variability is responsible for the overlap of two data sets and that an increase in variability can increase the overlap.</li> <li>3. Median is paired with the interquartile range and mean is paired with the mean absolute deviation.</li> </ol> <p><b><u>Example:</u></b></p> <p>Jason wanted to compare the mean height of the players on his favorite basketball and soccer teams. He thinks the mean height of the players on the basketball team will be greater but doesn't know how much greater.</p> <p>He also wonders if the variability of heights of the athletes is related to the sport they play. He thinks that there will be a greater variability in the heights of soccer players as compared to basketball players.</p> <p>He used the rosters and player statistics from the team websites to generate the following lists.</p> <p>Basketball Team – Height of Players in inches for 2010 Season</p>

<p>(mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.</p>	<p>7.MP.7. Look for and make use of structure.</p>	<p>75, 73, 76, 78, 79, 78, 79, 81, 80, 82, 81, 84, 82, 84, 80, 84</p> <p>Soccer Team – Height of Players in inches for 2010 73, 73, 73, 72, 69, 76, 72, 73, 74, 70, 65, 71, 74, 76, 70, 72, 71, 74, 71, 74, 73, 67, 70, 72, 69, 78, 73, 76, 69</p>  <p style="text-align: center;"><b>Height of Soccer Players (in)</b></p> <p style="text-align: center;"><b>Height of Basketball Players (in)</b></p> <p>To compare the data sets, Jason creates two dot plots on the same scale. The shortest player is 65 inches and the tallest players are 84 inches.</p> <p>In looking at the distribution of the data, Jason observes that there is some overlap between the two data sets. Some players on both teams have players between 73 and 78 inches tall. Jason decides to use the mean and mean absolute deviation to compare the data sets.</p> <p>The mean height of the basketball players is 79.75 inches as compared to the mean height of the soccer players at 72.07 inches, a difference of 7.68 inches.</p> <p>The mean absolute deviation (MAD) is calculated by taking the mean of the absolute deviations for each data point. The difference between each data point and the mean is</p>
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		<p>recorded in the second column of the table The difference between each data point and the mean is recorded in the second column of the table. Jason used rounded values (80 inches for the mean height of basketball players and 72 inches for the mean height of soccer players) to find the differences. The absolute deviation, absolute value of the deviation, is recorded in the third column. The absolute deviations are summed and divided by the number of data points in the set.</p> <p>The mean absolute deviation is 2.14 inches for the basketball players and 2.53 for the soccer players. These values indicate moderate variation in both data sets.</p> <p><b>Solution:</b> There is slightly more variability in the height of the soccer players.</p> <p>The difference between the heights of the teams (7.68) is approximately 3 times the variability of the data sets (<math>7.68 \div 2.53 = 3.04</math>; <math>7.68 \div 2.14 = 3.59</math>).</p>
<p><b>7.SP.B.4. Use measures of center and measures of variability</b> for numerical data from random samples to draw informal comparative inferences about two populations. <i>For example, decide whether the words in a chapter of a seventh-grade science book are generally longer</i></p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p>	<p>Students compare two sets of data using measures of center (mean and median) and variability (MAD and IQR).</p> <p>Showing the two graphs vertically rather than side by side helps students make comparisons.</p> <p>For example, students would be able to see from the display of the two graphs that the ideas scores are generally higher than the organization scores.</p> <p>One observation students might make is that the scores for organization are clustered around a score of 3 whereas the scores for ideas are clustered around a score of 5.</p> <p><b>Solution:</b>  Mean = <math>2090 \div 29 = 72</math> inches                      Mean = <math>1276 \div 16 = 80</math> inches  MAD = <math>62 \div 29 = 2.14</math> inches                      MAD = <math>40 \div 16 = 2.53</math> inches</p> <p>See table below.</p>

<i>than the words in a chapter of a fourth-grade science book.</i>	<p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p>	<b>Soccer Players (n = 29)</b>			<b>Basketball Players (n = 16)</b>		
		Height (in)	Deviation from Mean (in)	Absolute Deviation (in)	Height (in)	Deviation from Mean (in)	Absolute Deviation (in)
		65	-7	7	73	-7	7
		67	-5	5	75	-5	5
		69	-3	3	76	-4	4
		69	-3	3	78	-2	2
		69	-3	3	78	-2	2
		70	-2	2	79	-1	1
		70	-2	2	79	-1	1
		71	-1	1	80	0	0
		71	-1	1	80	0	0
		71	-1	1	81	+1	1
		72	0	0	81	+1	1
		72	0	0	82	+2	2
		72	0	0	82	+2	2
		72	0	0	84	+4	4
		73	+1	1	84	+4	4
		73	+1	1	84	+4	4
		73	+1	1			
		73	+1	1			
		73	+1	1			
		73	+1	1			
		74	+2	2			
		74	+2	2			
		74	+2	2			
		74	+2	2			
		76	+4	4			
		76	+4	4			
		76	+4	4			
		78	+6	6			
		$\Sigma = 2090$		$\Sigma = 62$	$\Sigma = 1276$		$\Sigma = 40$

<p><b>7.SP.C.5.</b> <b>Understand</b> that the <b>probability of a chance event</b> is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around <math>\frac{1}{2}</math> indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.</p>	<p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p>	<p>This is the students' first formal introduction to probability. Students recognize that the probability of any single event can be expressed in terms such as impossible, unlikely, likely, or certain or as a number between 0 and 1, inclusive, as illustrated on the number line below.</p> <p>The closer the fraction is to 1, the greater the probability the event will occur. Larger numbers indicate greater likelihood.</p> <p>Marble Mania - <a href="http://www.sciencenetlinks.com/interactives/marble/marblemania.html">http://www.sciencenetlinks.com/interactives/marble/marblemania.html</a></p> <p>Random Drawing Tool - <a href="http://illuminations.nctm.org/activitydetail.aspx?id=67">http://illuminations.nctm.org/activitydetail.aspx?id=67</a></p> <div data-bbox="1008 568 1659 828"> <p style="text-align: center;"> <math>0</math>                      <math>\frac{1}{2}</math>                      <math>1</math>  impossible    unlikely    equally likely    likely    certain </p> </div> <p>The closer the fraction is to 1, the greater the probability the event will occur.</p> <p>Larger numbers indicate greater likelihood. For example, if someone has 10 oranges and 3 apples, you have a greater likelihood of selecting an orange at random.</p> <p>Students also recognize that the sum of all possible outcomes is 1.</p> <p><b>Example 1:</b>  There are three choices of jellybeans – grape, cherry and orange. If the probability of getting a grape is <math>\frac{3}{10}</math> and the probability of getting cherry is <math>\frac{1}{5}</math>, what is the probability of getting orange?</p>
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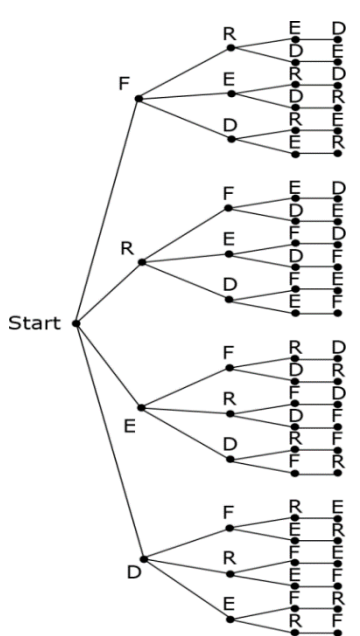
		<p><b><i>Solution:</i></b> The combined probabilities must equal 1. The combined probability of grape and cherry is <math>\frac{5}{10}</math>. The probability of orange must equal <math>\frac{5}{10}</math> to get a total of 1.</p> <p><b><i>Example 2:</i></b> The container below contains 2 gray, 1 white, and 4 black marbles. Without looking, if Eric chooses a marble from the container, will the probability be closer to 0 or to 1 that Eric will select a white marble? A gray marble? A black marble? Justify each of your predictions.</p>  <p><b><i>Solution:</i></b> White marble: Closer to 0 Gray marble: Closer to 0 Black marble: Closer to 1</p> <p>Students can use simulations such as Marble Mania on AAAS or the Random Drawing Tool on NCTM's Illuminations to generate data and examine patterns.</p> <p>Marble Mania <a href="http://www.sciencenetlinks.com/interactives/marble/marblemania.html">http://www.sciencenetlinks.com/interactives/marble/marblemania.html</a> Random Drawing Tool - <a href="http://illuminations.nctm.org/activitydetail.aspx?id=67">http://illuminations.nctm.org/activitydetail.aspx?id=67</a></p>
<p><b>7.SP.C.6.</b> Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-</p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p>	<p>Students collect data from a probability experiment, recognizing that as the number of trials increase, the experimental probability approaches the theoretical probability.</p> <p>The relative frequency is the observed number of successful events for a finite sample of trials. Relative frequency is the observed proportion of successful event, expressed as the value calculated by dividing the number of times an event occurs by the total number of times an experiment is carried out.</p>

<p>run relative frequency, and predict the approximate relative frequency given the probability. <i>For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.</i></p>	<p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p>	<p><b>Example 1:</b> Suppose we toss a coin 50 times and have 27 heads and 23 tails. We define a head as a success. The relative frequency of heads is: = 54% The probability of a head is 50%.</p> <p>The difference between the relative frequency of 54% and the probability of 50% is due to small sample size. The probability of an event can be thought of as its long-run relative frequency when the experiment is carried out many times.</p>
<p><b>7.SP.C.7. Develop</b> a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.</p> <p>a. <b>Develop</b> a uniform probability model by assigning</p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.3. Construct viable arguments and critique the reasoning of others.</p> <p>7.MP.4. Model with mathematics.</p>	<p>Probabilities are useful for predicting what will happen over the long run. Using theoretical probability, students predict frequencies of outcomes. Students recognize an appropriate design to conduct an experiment with simple probability events, understanding that the experimental data give realistic estimates of the probability of an event but are affected by sample size.</p> <p>Students need multiple opportunities to perform probability experiments and compare these results to theoretical probabilities. Critical components of the experiment process are making predictions about the outcomes by applying the principles of theoretical probability, comparing the predictions to the outcomes of the experiments, and replicating the experiment to compare results.</p> <p>Experiments can be replicated by the same group or by compiling class data. Experiments can be conducted using various random generation devices including, but not limited to, bag pulls, spinners, number cubes, coin toss, and colored chips. Students can collect data using physical objects or graphing calculator or web-based simulations. Students can also develop models for geometric probability (i.e. a target).</p>

<p>equal probability to all outcomes, and use the model to determine probabilities of events. <i>For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.</i></p> <p>b. <b>Develop</b> a <b>probability model</b> (which may not be uniform) by observing frequencies in data generated from a chance process. <i>For example, find the approximate probability that a spinning penny will land heads</i></p>	<p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.6. Attend to precision.</p> <p>7.MP.7. Look for and make use of structure.</p> <p>7.MP.8. Look for and express regularity in repeated reasoning.</p>	<p><b>Example 1:</b> If Mary chooses a point in the square, what is the probability that it is not in the circle?</p> <div data-bbox="1614 365 1816 568" data-label="Image"> </div> <p><b>Solution:</b> The area of the square would be <math>12 \times 12</math> or 144 units squared. The area of the circle would be 113.04 units squared. Area of the circle divide by the area of the square = .785 If you then subtract this from 1 ( as the certainty of 1) = .215 The probability that a point is not in the circle would be 21.5%.</p> <p><b>Example 2:</b> Jason is tossing a fair coin. He tosses the coin ten times and it lands on heads eight times. If Jason tosses the coin an eleventh time, what is the probability that it will land on heads?</p> <p><b>Solution:</b> The probability would be <math>\frac{1}{2}</math>. The result of the eleventh toss does not depend on the previous results.</p> <p><b>Example 3:</b> Devise an experiment using a coin to determine whether a baby is a boy or a girl. Conduct the experiment ten times to determine the gender of ten births. How could a number cube be used to simulate whether a baby is a girl or a boy or girl?</p>
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<p><i>up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?</i></p>		<p><b>Example 4:</b> Conduct an experiment using a Styrofoam cup by tossing the cup and recording how it lands.</p> <ul style="list-style-type: none"> <li>• How many trials were conducted?</li> <li>• How many times did it land right side up?</li> <li>• How many times did it land upside down?</li> <li>• How many times did it land on its side?</li> <li>• Determine the probability for each of the above results.</li> </ul> <p>When creating probability models, students form a ratio with the number of outcomes over the total number of trials.</p>
<p><b>7.SP.C.8.</b> Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.</p> <p>a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.</p>	<p>7.MP.1. Make sense of problems and persevere in solving them.</p> <p>7.MP.2. Reason abstractly and quantitatively.</p> <p>7.MP.4. Model with mathematics.</p> <p>7.MP.5. Use appropriate tools strategically.</p> <p>7.MP.7. Look for and make use of structure.</p> <p>7.MP.8. Look for and express regularity in repeated reasoning.</p>	<p>Students use tree diagrams, frequency tables, and organized lists, and simulations to determine the probability of compound events.</p> <p><b>Example 1:</b> Show all possible arrangements of the letters in the word FRED using a tree diagram. If each of the letters is on a tile and drawn at random, what is the probability that you will draw the letters F-R-E-D in that order? What is the probability that your “word” will have an F as the first letter?</p>

<p>b. <b>Represent</b> sample spaces for <b>compound events</b> using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the event.</p> <p>c. <b>Design and use a simulation</b> to generate <b>frequencies for compound events.</b> <i>i.e. use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4</i></p>		<p><b><i>Solution:</i></b> There are 24 possible arrangements (4 choices • 3 choices • 2 choices • 1 choice)</p> <p>The probability of drawing F-R-E-D in that order is <math>\frac{1}{24}</math>.</p> <p>The probability that a “word” will have an F as the first letter is <math>\frac{6}{24}</math> or <math>\frac{1}{4}</math>.</p>  <p><b><u>Example 2:</u></b> How many ways could the 3 students, Amy, Brenda, and Carla, come in 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> place?</p> <p><b><i>Solution:</i></b> Making an organized list will identify that there are 6 ways for the students to win a race</p> <p>A, B, C A, C, B B, C, A B, A, C C, A, B C, B, A</p>
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<p><i>donors to find one with type A blood?</i></p>		<p><b><u>Example 3:</u></b> A fair coin will be tossed three times. What is the probability that two heads and one tail in any order will results?</p> <p><b><i>Solution:</i></b> HHT, HTH and THH so the probability would be <math>\frac{3}{8}</math>.</p>
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