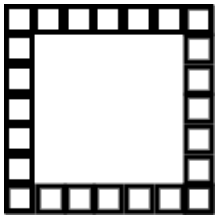
Georgia Department of Education

7th Grade

Opening Activity



1. Given a square pool as shown in the picture, write four different expressions to find the total number of tiles in the border.

2. Explain how each of the expressions relates to the diagram and demonstrate that the expressions are equivalent.

3. Which expression do you think is most useful? Explain your thinking.

Arizona Department of Education

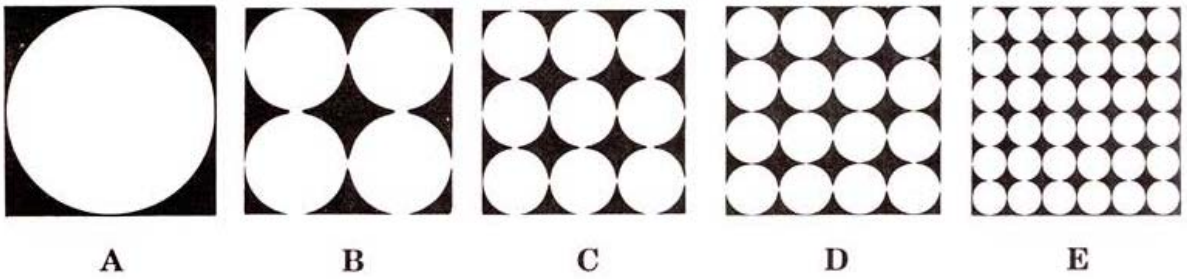
What's New

Ratios and Proportional Relationships
Proportional relationships represented by equations – came from 6th grade
Graphing proportional relationships with explanation within context – came from 6th grade
Using Proportional relationships to solve multistep ratio and percent problems – came from 6th grade
The Number System
Defining a rational number in terms of a decimal – not specifically mentioned
Expressions and Equations
Solve and graph inequalities in one variable – came from 8th grade
Geometry
Introduction of scale factor – came from 6th grade
Derive formulas for area and circumference of a circle – came from 5th grade
Complementary and supplementary angles and angles formed from intersecting lines – came from 8th grade
Solve real-life and mathematical problems involving area, surface area, and volume – came from 6th grade
Statistics and Probability
Probability of a chance event – came from 6th grade
Predicting frequency based on probability – came from 6th grade
Determine basic probability from probability models – came from 8th grade
Find the probability of compound events – came from 8th grade

Focus Activity

DART THROWING

Figures A through E represent targets for dart throwing.



Suppose that you can earn points by throwing darts according to these rules:

1 point, if your dart lands inside a circle
0 points, if your dart lands inside a square but outside a circle
Darts thrown outside a square do not count (are thrown again)

1. Which target would you choose to throw at? Why?

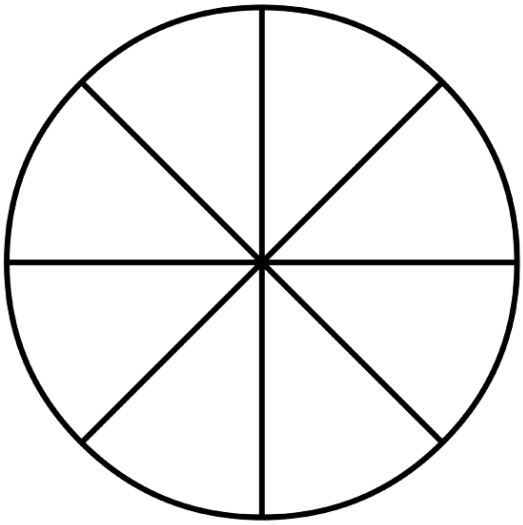
2. How can you support your answer mathematically?
   Hint 1: Think about the combined areas of circles within a square and the area of that square.
   Hint 2: What is a "nice" number to choose for the side length of the squares in order to perform calculations easily?

3. Describe your plan in words.

4. Show your calculations and results.

5. What do you conclude?

Coherence Activity



Area of a Circle

Circles and Parallelograms

Cut the sectors of the circle apart and arrange them on the grid paper to form a parallelogram.

1. Use the grid paper to help you approximate the area of the "parallelogram" formed. What is the approximate area of the "parallelogram" formed from the circle?

2. Calculate the area of the "parallelogram" using the formula for the area of a parallelogram. What do you notice?

3. Rewrite the formula for the parallelogram in terms of the circle.

4. Use your new formula to calculate the area of the circle.

5. Compare the area of the parallelogram you approximated above with the area of the circle you found using your new formula. What do you notice?

Overview of Middle School Math

6th Grade

1. Connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems

Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.

2. Completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers

Students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understandings of number and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.

3. Writing, interpreting, and using expressions and equations

Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as $3x = y$) to describe relationships between quantities.

4. Developing understanding of statistical thinking

Building on and reinforcing their understanding of number, students begin to develop their ability to think statistically. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range or mean absolute deviation) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data were collected.

Students in Grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in Grade 7 by drawing polygons in the coordinate plane.

7th Grade

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.

8th Grade

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.

Deep Understanding Activity

Two players each hold between one and three fingers behind their backs, then hold out their hands at the same time:

- Player A wins if the sum of the number of fingers is even.
- Player B wins if the sum of the number of fingers is odd.

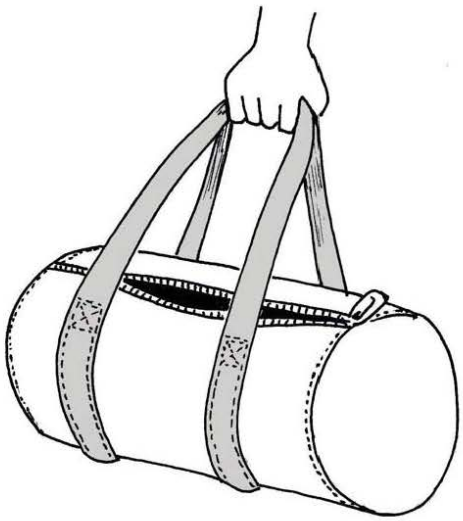
Suppose that each player selects randomly among the three choices. Determine whether this game is fair by constructing the possible outcomes.

Learning Math/Learner.org

Application Activity

Designing a Sports Bag

You have been asked to design a sports bag.



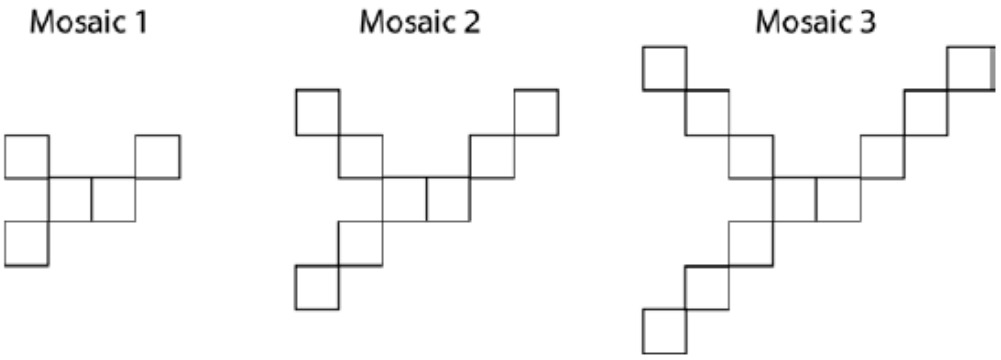
- The length of the bag will be 20 inches.
- The bag will have circular ends of diameter 11 inches.
- The main body of the bag will be made from 3 pieces of material: a piece for the curved body, and the two circular end pieces.
- Each piece will need to have an extra ½ inch hem all around it, so that the pieces may be stitched together.

1. Make a sketch of the pieces you will need to cut out for the body of the bag. On your sketch, show all the measurements you will need.

2. Suppose you are going to make one of these bags from a roll of cloth 1 yard wide. What is the shortest length of cloth you could cut from the roll? Describe, using words and sketches, how you arrive at your answer.

Balanced Approach Activity

Mosaics



Reuben learned in art class that a mosaic is made by arranging small pieces of colored material (such as glass or tile) to create a design. Reuben created a mosaic using tiles, then decided on a growing pattern and created a second and third mosaic. Reuben continued his pattern by building additional mosaics. He counted the number of tiles in each mosaic and then represented the data in multiple ways. He thinks he sees a relationship between the mosaic number and the total number of tiles in the mosaic.

1. Represent Reuben's data from the mosaics problem in at least three ways, including a general function rule, to determine the number of tiles in any mosaic.

2. Write a description of how your rule is related to the mosaic picture. Include a description of what is constant and what is changing as tiles are added.

3. How many tiles would be in the tenth mosaic? Use two different representations to show how you determined your answer.

4. Would there be a mosaic in Reuben's set that uses exactly 57 tiles? Explain your reasoning using at least one representation.

5. In Reuben's mosaic, there are 2 tiles in the center. How would the function rule change if the center of the mosaic contained 4 tiles instead? Explain your reasoning using two different representations.

What's in 7B – 8A

Unit 1	Unit 2	Unit 3
Inferences	**Geometry**	**Probability**
Use random sampling to draw inferences about a population. **MCC7.SP.1** Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. **MCC7.SP.2** Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions **Draw informal comparative inferences about two populations.** **MCC7.SP.3** 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. **MCC7.SP.4** Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.	**Draw, construct, and describe geometrical figures and describe the relationships between them.** **MCC7.G.2** Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. **MCC7.G.3** Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. **Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.** **MCC7.G.4** Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. **MCC7.G.5** 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. **MCC7.G.6** Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles,	**Investigate chance processes and develop, use, and evaluate probability models.** **MCC7.SP.5** Understand that the probability of a chance event 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 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event. **MCC7.SP.6** Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. **MCC7.SP.7** Develop 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. **MCC7.SP.7a** Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events **MCC7.SP.7b** Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. **MCC7.SP.8** Find probabilities of compound events using organized

	quadrilaterals, polygons, cubes, and right prisms.	lists, tables, tree diagrams, and simulation. **MCC7.SP.8a** 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. **MCC7.SP.8b** Represent sample spaces for compound events 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. **MCC7.SP.8c** Design and use a simulation to generate frequencies for compound events.
Unit 4	Unit 5	Unit 6
Transformations, Congruence and Similarity	**Exponents**	**Geometric Applications of Exponents**
Understand congruence and similarity using physical models, transparencies, or geometry software. **MCC8.G.1** Verify experimentally the properties of rotations, reflections, and translations: 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. **MCC8.G.2** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.	**Work with radicals and integer exponents.** **MCC8.EE.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions. **MCC8.EE.2** Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. **MCC8.EE.3** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. **MCC8.EE.4** Perform operations	**Understand and apply the Pythagorean Theorem.** **MCC8.G.6** Explain a proof of the Pythagorean Theorem and its converse. **MCC8.G.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **MCC8.G.8** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. **Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.** **MCC8.G.9** Know the formulas for the volume of cones, cylinders,

MCC8.G.3 Describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates. **MCC8.G.4** Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. **MCC8.G.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.	with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. **Analyze and solve linear equations and pairs of simultaneous linear equations.** **MCC8.EE.7** Solve linear equations in one variable. **MCC8.EE.7a** Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form , , or results (where and are different numbers). **MCC8.EE.7b** Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. **Know that there are numbers that are not rational, and approximate them by rational numbers.** **MCC8.NS.1** Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats	and spheres and use them to solve real-world and mathematical problems. **Work with radicals and integer exponents.** **MCC8.EE.2** Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

	eventually into a rational number. **MCC8.NS.2** Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2).	
Unit 7	Unit 8	Unit 9
Functions	**Linear Functions**	**Linear Models and Tables**
Define, evaluate, and compare functions. **MCC8.F.1** Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. **MCC8.F.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	**Understand the connections between proportional relationships, lines, and linear equations.** **MCC8.EE.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. **MCC8.EE.6** Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation for a line through the origin and the equation for a line intercepting the vertical axis at b. **Define, evaluate, and compare functions.** **MCC8.F.3** Interpret the equation as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.	**Use functions to model relationships between quantities.** **MCC8.F.4** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. **MCC8.F.5** Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. **Investigate patterns of association in bivariate data.** **MCC8.SP.1** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear

		association. **MCC8.SP.2** Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. **MCC8.SP.3** Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. **MCC8.SP.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.
Unit 10		
Solving Systems of Equations		
<u>Analyze and solve linear equations and pairs of simultaneous linear equations.</u> **MCC8.EE.8** Analyze and solve pairs of simultaneous linear equations. **MCC8.EE.8a** Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. **MCC8.EE.8b** Solve systems of two linear equations in two		

variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. **MCC8.EE.8c** Solve real-world and mathematical problems leading to two linear equations in two variables.		