

# Georgia Department of Education

8<sup>th</sup> Grade

## Opening Task

Using the Pythagorean Theorem determine the distance from (1, 9) to (3, 3).

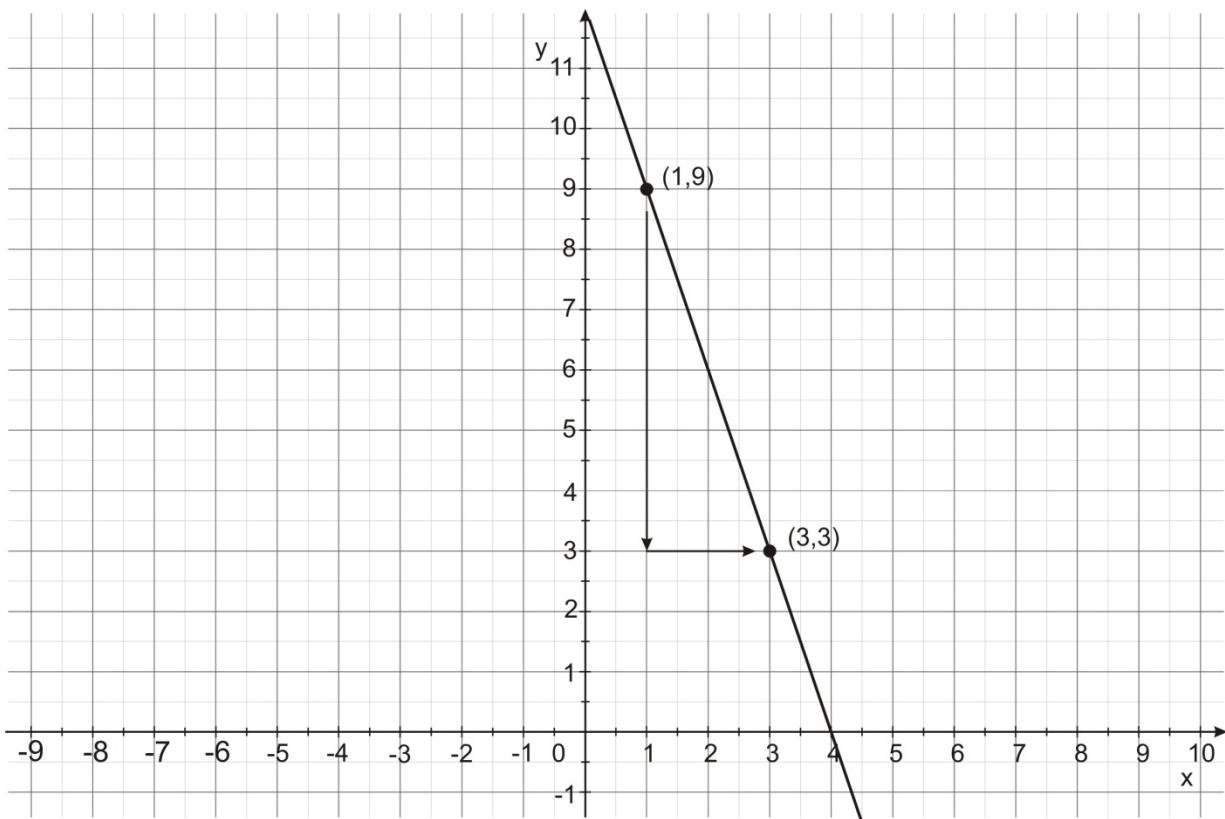


Image from [ocw.openhighschool.org](http://ocw.openhighschool.org)

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## What's New

### **The Number System**

Cube Root – came from high school

### **Expressions and Equations**

Similar triangles → slope – Not addressed in this manner

### **Functions**

Increasing/Decreasing Functions – came from high school

### **Geometry**

Transformation – came from 7<sup>th</sup> grade

Similarity – came from 7<sup>th</sup> grade

Congruence – not addressed in this manner

Sums of angles in triangle –interior from 4<sup>th</sup> grade / exterior from high school

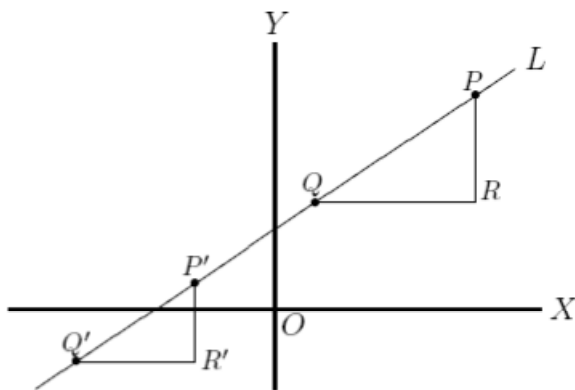
Distance Using Pythagorean Theorem – came from high school

Volumes of cones, cylinders, & Spheres – came from cones and cylinders from 6<sup>th</sup> grade / spheres from high school

### **Statistics and Probability**

Two-way Tables – came from 7<sup>th</sup> grade

## Focus Task

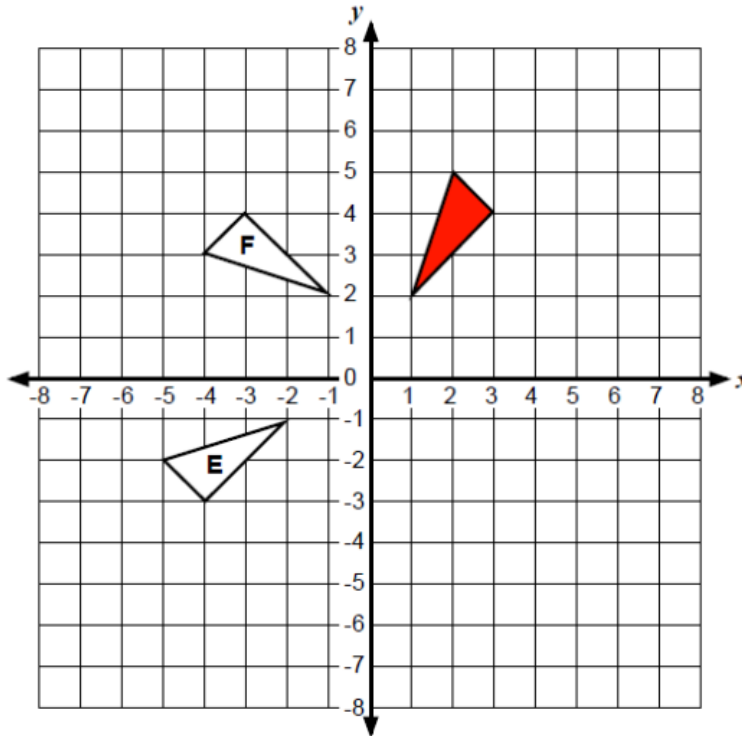


Prove that the slope from Q to P is the same as Q' to P', ie.  $\frac{y_P - y_Q}{x_P - x_Q} = \frac{y_{P'} - y_{Q'}}{x_{P'} - x_{Q'}}$

Adapted from Introduction to School Algebra [Draft], H. Wu, July 24, 2010

**Coherence Task**

**Transformations**



1. Draw the shaded triangle after:
  - a) It has been translated  $-7$  horizontally and  $+1$  vertically. Label your answer *A*.
  - b) It has been reflected over the  $x$ -axis. Label your answer *B*.
  - c) It has been rotated  $90^\circ$  clockwise around the origin. Label your answer *C*.
  - d) It has been reflected over the line  $y = x$ . Label your answer *D*.
2. Describe fully the single transformation that:
  - a) Takes the shaded triangle onto the triangle labeled *E*.

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b) Takes the shaded triangle onto the triangle labeled *F*.

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### Overview of Middle School Math

#### **6<sup>th</sup> 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.

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### 7<sup>th</sup> 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.

**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.

## CONGRUENT FIGURES 2

Two figures are congruent if there is a sequence of translations, reflections, and rotations of the plane onto itself that maps one figure onto the other.

Each of these pairs of figures can be shown to be congruent through a sequence of rotations, reflections, and translations. Use patty paper as needed. Describe in words (1) why you believe this is an isometry, and (2) what happened to the plane under this transformation.

<p>1.</p>	<p>2.</p>
<p>3.</p>	<p>4.</p>

5. Make up your own problem. Draw two congruent triangles on a piece of graph paper. Then figure out how to obtain the second one from the first by a series of translations, reflections, and rotations. Trade problems with a friend. See if you can solve your friend's problem.

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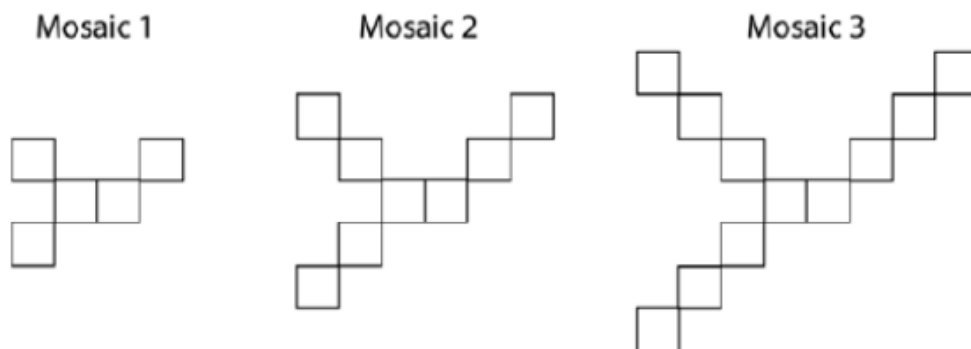
### Application Task

1. Laine Ellington had a babysitting service the summer before she left for Georgia Tech. She earned \$1200. While she did spend some of it on new college clothes, she saved quite a bit to have some spending money while away at college. The following table shows her bank account balance over a 9-week period in the fall semester.

Week Number	1	2	3	4	5	6	7	8	9
Money Left	810	788	770	745	715	692	668	640	615

- Make a scatterplot of Laine's bank balance data. Draw a line that models the trend in that plot.
- Write an equation for the linear model. Use  $W$  for weeks and  $M$  for money left. Remember that money left depends on the week number.
- Predict Laine's bank balance after 10, 15, and 20 weeks.
- Explain how the patterns in the table, graph, and equation are related to each other. What do they say about Laine's spending habits?



Balanced Approach Task**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.

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### What's in 7B - 8

Unit 1	Unit 2	Unit 3
<b>Inferences</b>	<b>Geometry</b>	<b>Probability</b>
<p><b><u>Use random sampling to draw inferences about a population.</u></b>  <b>MCC7.SP.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 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.  <b>MCC7.SP.2</b> 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  <b><u>Draw informal comparative inferences about two populations.</u></b>  <b>MCC7.SP.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.  <b>MCC7.SP.4</b> Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.</p>	<p><b><u>Draw, construct, and describe geometrical figures and describe the relationships between them.</u></b>  <b>MCC7.G.2</b> 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.  <b>MCC7.G.3</b> Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.  <b><u>Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.</u></b>  <b>MCC7.G.4</b> 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.  <b>MCC7.G.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.  <b>MCC7.G.6</b> Solve 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><b><u>Investigate chance processes and develop, use, and evaluate probability models.</u></b>  <b>MCC7.SP.5</b> 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.  <b>MCC7.SP.6</b> 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.  <b>MCC7.SP.7</b> 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.  <b>MCC7.SP.7a</b> Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events  <b>MCC7.SP.7b</b> Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.  <b>MCC7.SP.8</b> Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.  <b>MCC7.SP.8a</b> 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.  <b>MCC7.SP.8b</b> 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.  <b>MCC7.SP.8c</b> Design and use a simulation to generate frequencies for compound events.</p>