



# PISCATAWAY TOWNSHIP SCHOOLS

**Dr. Frank Ranelli**

Superintendent of Schools

**Dr. William Baskerville**

Assistant Superintendent for  
Curriculum and Instruction

## Math 8

**Content Area: Mathematics**

**Grade Span: 8**

**Revised by:**

Julia Cabrero, Instructional Coach  
Kyle Gurgkovich, MS Mathematics  
Emily Slavik, MS Mathematics

**Presented By:**

Frank Wrublevski, Supervisor of Mathematics 7-12

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**Members of the Board of Education**

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Shantell Cherry – Vice President

Nancy Corradino

Ralph Johnson

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Sarah Rashid

Zoe Scotto

Brenda Smith

**Piscataway Township Schools**

1515 Stelton Road

Piscataway, NJ 08854-1332

732 572-2289, ext. 2561

Fax 732 572-1540

[www.piscatawayschools.org](http://www.piscatawayschools.org)

# COURSE OVERVIEW

## Description

Math 8 builds on what students have learned about proportional and geometric relationships in Math 7 to develop several key concepts in algebra and geometry. Students start the year with rigid transformations and congruence in Unit 1, which sets them up to learn about similarity and dilations in Unit 2. Students use what they know about similar triangles to explore slope as they study linear relationships in Unit 3. This work with linear relationships builds toward solving linear equations with variables on both sides of the equal sign, and systems of linear equations in Unit 4.

Unit 5 invites students to consider functions, specifically what makes a relationship a function. Unit 5 also explores the volumes of cylinders, cones, and spheres. Unit 6 returns to linear relationships as students explore bivariate data. Unit 7 builds on the exponent work from Math 6 to explore properties of exponents and scientific notation as a tool for representing very large and very small quantities. Math 8 ends with the Pythagorean theorem as students encounter square roots, cube roots, and irrational numbers for the first time.

Students will investigate the Math 8 curriculum through a lens of the 8 Standards of Mathematical Practice.

## Goals

### ***The Number System***

- Know that there are numbers that are not rational, and approximate them by rational numbers.

### ***Expressions and Equations***

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

### ***Functions***

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

### ***Geometry***

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

### ***Statistics and Probability***

- Investigate patterns of association in bivariate data.

### ***Mathematical Practices***

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

<b>Scope and Sequence</b>		
<b>Unit</b>	<b>Topic</b>	<b>Length</b>
Unit 1	Rigid Transformations and Congruence	20-23 days
Unit 2	Dilations, Similarity, and Introducing Slope	16-18 days
Unit 3	Proportional and Linear Relationships	16-18 days
Unit 4	Linear Equations and Linear Systems	20-22 days
Unit 5	Functions and Volume	22-24 day
Unit 6	Associations in Data	17-18 days
Unit 7	Exponents and Scientific Notation	19-20 days
Unit 8	The Pythagorean Theorem and Irrational Numbers	20-22 days
<b>Resources</b>		
<p><b>Core Text:</b>  <a href="https://www.desmos.com/curriculum">https://www.desmos.com/curriculum</a></p> <p><b>Suggested Resources:</b>  Delta Math, Standardized Test Items, IXL,  other internet and book-based resources</p>		

# UNIT 1: Rigid Transformations and Congruence

<b>Summary and Rationale</b>	
<p>This unit gives consistent practice in the topics of transformations, congruence, and angle relationships with triangles and parallel lines. Students will perform the transformations, use this understanding to define congruence and then learn to apply congruence properties. Students learn and use the word <i>congruent</i> and come to understand how congruent figures are related to <i>rigid transformations</i>. This builds on work students did in Grade 7 sketching geometric shapes given specific conditions. In high school, students will prove shortcuts for determining congruent triangles. Students use transformations to discover new angle relationships. This builds on students' work with supplementary, complementary, vertical, and adjacent angles from Grade 7.</p>	
<b>Recommended Pacing</b>	
20-23 days	
<b>State Standards</b>	
<b>Standard 8.G Geometry</b>	
CPI #	Cumulative Progress Indicator (CPI)
1	Verify experimentally the properties of rotations, reflections, and translations
1a	Verify experimentally the properties of rotations, reflections, and translations: Lines are transformed to lines, and line segments to line segments of the same length.
1b	Verify experimentally the properties of rotations, reflections, and translations: Angles are transformed to angles of the same measure.
1c	Verify experimentally the properties of rotations, reflections, and translations: Parallel lines are transformed to parallel lines.
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.
3	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates
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. <i>For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.</i>
<b>Instructional Focus</b>	
<b>Unit Enduring Understandings</b>	
<ul style="list-style-type: none"> <li>• Transformations can aid in modeling, identifying, interpreting, and describing relationships.</li> <li>• Geometric relationships provide a means to make sense of a variety of phenomena.</li> </ul>	
<b>Unit Essential Questions</b>	
<ul style="list-style-type: none"> <li>• How are transformations used as a tool to aid in problem solving?</li> <li>• How do spatial sense and geometric relationships help to make sense of phenomena?</li> <li>• How can geometric relationships aid in understanding the real-world?</li> <li>• How do you describe the properties of translations and their effect on the congruence and orientation of figures?</li> <li>• How do you describe the properties of reflection and their effect on the congruence and orientation of figures?</li> </ul>	

- How do you describe the properties of rotation and their effect on the congruence and orientation of the figures?
- How can you describe the effect of a translation, rotation, or reflection on coordinates using an algebraic representation?
- What is the connection between transformations and figures that have the same shape and size?

## Objectives

### Students will know:

- Vocabulary related to congruence and similarity
- The impact of transformations on geometric figures.
- How an angle of rotation dictates the orientation of the image.
- The corresponding parts of congruent figures.
- Characteristics and properties of similar and congruent figures.
- A figure being congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and/or translations.
- Vocabulary related to angles and parallel lines
- The relationship among the various angles in geometric figures (triangles, intersecting lines, etc.) and parallel lines.

### Students will be able to:

#### *Perform Transformations*

- Describe translations, rotations, and reflections using informal language (e.g., “slide,” “turn left,” etc.)
- Compare and contrast translations, rotations, and reflections.
- Given two figures, identify and describe a sequence of transformations that takes one figure to another.
- Use the terms *translation*, *rotation*, and *reflection* to precisely describe transformations on a grid.
- Draw the image of a figure under a translation, rotation, or reflection on a grid.
- Apply transformations on a coordinate grid by applying the transformation to each endpoint and then connecting the dots.
- Apply transformations to a polygon by finding the image of its vertices and connecting the dots.

#### *Defining Congruence*

- Experiment with two-dimensional figures and decide what it means for them to be congruent.
- Observe that rigid transformations preserve lengths and angle measures.
- Understand that all corresponding distances between pairs of points are equal in congruent figures.
- Decide whether two figures on a grid are congruent by applying transformations.
- Understand that all corresponding sides in a pair of congruent polygons have the same length, but that congruent corresponding sides does not necessarily mean the polygons are congruent.

#### *Applying Congruence*

- Understand that lines are taken to lines and parallel lines are taken to parallel lines under rigid transformations.
- Establish the vertical angle theorem through informal arguments.
- Identify congruent angles on two parallel lines cut by a transversal and use them to determine missing angle measurements.
- Observe that the sum of the angles in a triangle is  $180^\circ$  degrees.
- Use rigid transformations to informally establish the triangle sum theorem (the sum of the angle measures in any triangle is  $180^\circ$  degrees).
- Build and study complex patterns using the language of transformations.

## Resources

**Core Text:**

<https://www.desmos.com/curriculum>

**Suggested Resources:**

Delta Math, Standardized Test Items, IXL,  
other internet and book-based resources

## UNIT 2: Dilations, Similarity, and Introducing Slope

<b>Summary and Rationale</b>	
<p>This unit gives consistent practice in the topics of transformations, congruence, similarity, angle relationships, and the Pythagorean Theorem. Students will work to understand how dilations differ from translations, reflections, rotations, dilations, and how similarity is developed using this concept. Students will also begin to develop an understanding of how similarity and slope are connected.</p>	
<b>Recommended Pacing</b>	
16-18 days	
<b>State Standards</b>	
<b>Standard 8.EE Expressions and Equations</b>	
CPI #	Cumulative Progress Indicator (CPI)
6	Use similar triangles to explain why the slope $m$ is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$ .
<b>Standard 8.G Geometry</b>	
CPI #	Cumulative Progress Indicator (CPI)
3	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates
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.
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. <i>For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so</i>
<b>Instructional Focus</b>	
<b>Unit Enduring Understandings</b>	
<ul style="list-style-type: none"> <li>• Transformations can aid in modeling, identifying, interpreting, and describing relationships.</li> <li>• Geometric relationships provide a means to make sense of a variety of phenomena.</li> </ul>	
<b>Unit Essential Questions</b>	
<ul style="list-style-type: none"> <li>• What is the connection between transformations and figures that have the same shape and size?</li> <li>• How do you describe the properties of dilations?</li> <li>• How can you describe the effect of a dilation on coordinates using an algebraic representation?</li> <li>• What is the connection between transformations and the orientations of similar figures?</li> </ul>	
<b>Objectives</b>	
<p><b>Students will know:</b></p> <ul style="list-style-type: none"> <li>• Figures are similar if a scale factor produces proportional corresponding sides; and corresponding sides have the same slope.</li> <li>• Measurements that can be found using indirect methods.</li> </ul> <p><b>Students will be able to:</b></p> <ul style="list-style-type: none"> <li>• Understand that figures that are scaled copies of one another are similar figures.</li> <li>• Identify the center and scale factor used in a dilation.</li> </ul>	

- Apply dilations to figures using distance measurements.
- Apply dilations to figures on a grid.
- Describe how scale factors greater than `1`, between `0` and `1`, or equal to `1` affect the size of an image, its angle measures, and its distance from the center of dilation.
- Describe and apply dilations to polygons on a grid given the coordinates of the vertices and the center of dilation.
- Apply a sequence of transformations to show that two figures are similar.
- Understand that when two polygons are similar, their corresponding angles are all congruent *and* there is a single scale factor by which we can multiply all of the side lengths in one figure to get the corresponding side lengths in the other.
- Understand that congruent corresponding angles alone are not sufficient for establishing similarity.
- Understand that for the special case of triangles, two pairs of congruent corresponding angles are sufficient for establishing similarity.
- Understand that for similar triangles, the quotient of two side lengths in one triangle is equal to the quotient of the corresponding side lengths in the other triangle.
- Determine missing side lengths in pairs of similar triangles using quotient relationships between side lengths.
- Show that all *slope triangles* on one line are similar and have the same slope.
- Determine the slope of a line in a plane.
- Explain whether a point is on a line by finding quotients of horizontal and vertical distances.

## Resources

### Core Text:

<https://www.desmos.com/curriculum>

### Suggested Resources:

Delta Math, Standardized Test Items, IXL, other internet and book-based resources



## UNIT 3: Proportional and Linear Relationships

<b>Summary and Rationale</b>	
<p>This unit gives consistent practice in the topics of proportional and nonproportional relationships and writing linear equations. Students revisit representations of proportional relationships. This builds on students' understanding of rates and proportional relationships in Grade 7. Students build on their knowledge from Unit 2 to identify slope and start writing linear equations. This work will support students in finding solutions to linear equations in Unit 4 and in analyzing linear functions in Unit 5. Students encounter and solve problems using equations of the form <math>Ax+By=C</math>. This work will support students in solving systems of linear equations in two variables in Unit 4.</p>	
<b>Recommended Pacing</b>	
16-18 days	
<b>State Standards</b>	
<b>Standard 8.EE Expressions and Equations</b>	
CPI #	Cumulative Progress Indicator (CPI)
5	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
6	Use similar triangles to explain why the slope $m$ is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$ .
7	Solve linear equations in one variable.
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 $x = a$ , $a = a$ , or $a = b$ results (where $a$ and $b$ are different numbers).
7b	Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
<b>Instructional Focus</b>	
<b>Unit Enduring Understandings</b>	
<ul style="list-style-type: none"> <li>• Relationships can be modeled in different forms.</li> <li>• There may not always be one solution to a problem.</li> <li>• Solutions depend on parameters.</li> </ul>	
<b>Unit Essential Questions</b>	
<ul style="list-style-type: none"> <li>• How can you distinguish between proportional and nonproportional situations?</li> <li>• How can you determine the slope and the y-intercept of a line?</li> <li>• How can you use tables, graphs, and equations to represent linear nonproportional situations?</li> <li>• What is the best way to represent, interpret, and solve a real-world situation?</li> </ul>	
<b>Objectives</b>	
<b>Students will know:</b>	
<ul style="list-style-type: none"> <li>• Proportional relationships being represented in different ways.</li> <li>• Proportionality being inherent in slope (rate of change).</li> </ul>	

- A variety of phenomena and relationships that can be modeled and analyzed using equations, tables, and/or graphic representations.
- The  $y$ -intercept representing where the function crosses the  $y$ -axis; as well as, an initial amount.
- How the slope and  $y$ -intercept relate to the equation, table, and graph.
- The coefficient of  $x$  being the rate of change; and that the initial value is the constant.
- The translation of word problems into equations.

**Students will be able to:**

- Remember that a graph representing a proportional relationship is a line through  $(0, 0)$  and  $(1, k)$ .
- Begin to see connections between a context and features of a corresponding graph, equation, and table.
- Graph a proportional relationship from an equation.
- Identify the same proportional relationship that is graphed using differently scaled axes.
- Compare two different proportional relationships given different representations of them.
- Understand that there are linear relationships that are not proportional.
- Recognize that the rate of change of a linear relationship is the same value as the slope of the graph of the relationship and interpret the slope of a graph.
- interpret a unit rate as a slope.
- express and compare nonproportional relationships of real-world situations using equations, tables, and graphs.
- Identify and interpret the positive vertical intercept of the graph of a linear relationship.
- interpret the meaning of a  $y$ -intercept in a real-world situation.
- compare relations as a set of ordered pairs, in a table, or on a graph.
- Write an equation for a linear relationship by expressing regularity in repeated reasoning.
- Derive  $y=mx+b$  by graphing  $y=mx$  and the same graph shifted up using the translation that takes  $(0, 0)$  to  $(0, b)$ .
- Connect the equations  $y=b+mx$  and  $y=mx+b$  to the graph.
- Encounter a graph where the  $y$ -intercept is a negative value.
- write an equation in slope intercept form given a graph, table, and word problem.
- Understand the difference in visual appearance between lines with positive slopes and lines with negative slopes.
- Interpret a line with a negative slope that represents a real-world situation.
- Generate a method to find slope values given two points on the line.
- determine the slope of a function given a graph and two ordered pairs including slopes that are undefined or zero.
- Write equations of horizontal and vertical lines.
- Write equations of lines that have a negative slope.
- Understand that linear equations don't always look like  $y=mx+b$ .
- Understand that the graph of an equation is a visual representation of all solutions to an equation.
- Define a solution to an equation in two variables.
- Notice features of equations that can make one variable easier or harder to solve for.

## Resources

**Core Text:**

<https://www.desmos.com/curriculum>

**Suggested Resources:**

Delta Math, Standardized Test Items, IXL,  
other internet and book-based resources

## UNIT 4: Linear Equations and Linear Systems

<b>Summary and Rationale</b>	
<p>This unit provides the opportunity for consistent practice in the topics of solving equations and finding the solution to a system of linear equations through graphing, substitution, and elimination. Students solve linear equations with variables on both sides of the equation. This builds on work from Grade 7, where students solved equations with variables on only one side of the equation. Students investigate systems of linear equations in two variables. This builds on students' work in solving linear equations in the first section and graphing linear relationships in Unit 3. The work in this unit prepares students to solve systems of more than two equations and those involving nonlinear equations in high school.</p>	
<b>Recommended Pacing</b>	
22-24 days	
<b>State Standards</b>	
<b>Standard 8.EE Expressions and Equations</b>	
CPI #	Cumulative Progress Indicator (CPI)
7	Solve linear equations in one variable.
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 $x = a$ , $a = a$ , or $a = b$ results (where $a$ and $b$ are different numbers).
7b	Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
8	Analyze and solve pairs of simultaneous linear equations.
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.
8b	Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.
8c	Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.
<b>Instructional Focus</b>	
<b>Unit Enduring Understandings</b>	
<ul style="list-style-type: none"> <li>• Real-life situations can be translated and interpreted by algebraic sentences.</li> <li>• Relationships can be modeled in different forms.</li> <li>• Solutions depend on parameters.</li> </ul>	
<b>Unit Essential Questions</b>	
<ul style="list-style-type: none"> <li>• How can you represent and solve equations with the variable on both sides?</li> <li>• How can you solve equations with rational number coefficients and constants?</li> <li>• How do you use the Distributive Property to solve equations?</li> <li>• How can you give examples of equations with a given number of solutions?</li> <li>• How can you solve a system of equations by graphing?</li> <li>• How do you use substitution to solve a system of linear equations?</li> <li>• How do you solve a system with no solutions or infinitely many solutions?</li> </ul>	

- How do conditions impact solutions?

## Objectives

### Students will know:

- Balance being a required condition for equations.
- The limitations of a solution.
- Equations by writing, interpreting, and solving.
- That solving a system of equations means finding values of the variables that make both equations true at the same time.
- Parallel lines having the same slope; and that intersecting lines have different slopes.
- Vocabulary related to systems in classroom discussions and assignments.
- How and why the number of solutions depends on the relationship between two linear equations.
- Different ways to solve a system of equations and when to utilize each method.
- How to write, interpret, and solve a system of equations for real-world applications.

### Students will be able to:

- Calculate a missing value for a number puzzle that can be represented by a linear equation with one variable, and explain (orally and in writing) the solution method.
- Create a number puzzle that can be represented by a linear equation with one variable.
- Calculate the weight of an unknown object using a hanger diagram, and explain the solution method.
- Understand that adding and removing equal items from each side of a hanger diagram or multiplying and dividing items on each side of the hanger by the same amount are moves that keep the hanger balanced.
- Correlate changes on hanger diagrams with moves that create equivalent equations.
- Calculate a value that is a solution to a linear equation with one variable, and compare and contrast solution strategies with others.
- Critique the reasoning of others in solving a linear equation with one variable.
- Calculate a value that is a solution to a linear equation with one variable, and explain the steps used to solve.
- Justify that each step used in solving a linear equation maintains equality.
- Categorize linear equations with one variable based on their structure, and solve equations from each category.
- Describe strategies for solving linear equations with one variable that have different features or structures.
- Compare and contrast equations that have no solutions or infinitely many solutions.
- Using structure, create linear equations with one variable that have either no solutions or infinitely many solutions, and explain the solution method.
- Create an equation with one variable to represent a situation in which two conditions are equal.
- Interpret the solution to an equation with one variable in context.
- balance being a required condition for equations.
- the limitations of a solution.
- equations by writing, interpreting, and solving.
- solve multi-step equations - include equations with rational number coefficients, applying the distributive property, and combining like terms.
- that linear one-variable equations can have one solution ( $x=a$ ), no solution ( $a=b$ ), or an infinite number of solutions ( $a=a$ ).
- write and solve equations that are based upon real-world situations/word problems.
- model a real-world problem using a linear system.
- Determine a point that satisfies two relationships simultaneously, using tables or graphs.
- Interpret points that lie on one, both, or neither line(s) of a graph of two simultaneous equations in context.

- Create a graph that represents two linear relationships in context, and interpret the point of intersection.
- Interpret a graph of two equivalent lines in context.
- Connect graphs of parallel lines and a system of equations that has no solutions.
- identify linear systems having one, none, or infinitely many solutions.
- Connect the solution of an equation with variables on each side to the solution of a system of two linear equations.
- Justify that a particular system of equations has one, infinite, or no solutions using the structure of the equations.
- Categorize systems of equations, including systems with infinitely many or no solutions, and calculate the solution for a system using a variety of strategies.
- Calculate values that are solutions to a system of equations, and explain the solution method.
- use the vocabulary related to systems of equations: system of equations, solution to a system, substitution
- solve systems of equations by using the methods of graphing and substitution
- choose the most efficient method of solving a system of linear equations.
- model a real-world problem using a linear system

## Resources

**Core Text:**

<https://www.desmos.com/curriculum>

**Suggested Resources:**

Delta Math, Standardized Test Items, IXL,  
other internet and book-based resources

## Unit 5: Functions and Volume

Summary and Rationale	
<p>Students will work to understand the characteristics of linear functions, what makes a function. This unit gives consistent practice in the topics of volume (cylinders, cones, spheres). Students will work to understand finding the radius given volume. Students learn what a function is and how it is represented in tables, graphs, and equations. Students create and interpret graphs of functions that represent stories, examining both individual points and rates of change.</p>	
Recommended Pacing	
22-24 days	
State Standards	
Standard 8.F Functions	
CPI #	Cumulative Progress Indicator (CPI)
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.
2	Compare properties (e.g. rate of change, intercepts, domain and range) of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.</i>
3	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.
4	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
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.
Standard 8.G Geometry	
CPI #	Cumulative Progress Indicator (CPI)
9	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
Instructional Focus	
Unit Enduring Understandings	
<ul style="list-style-type: none"> <li>• Relationships can be modeled in different forms.</li> <li>• There may not always be one solution to a problem.</li> <li>• Solutions depend on parameters.</li> <li>• The understanding of three-dimensional objects aid in solving real-world problems.</li> </ul>	
Unit Essential Questions	
<ul style="list-style-type: none"> <li>• How can you identify and represent functions?</li> <li>• What are some characteristics that you can use to describe functions?</li> <li>• How can you use tables, graphs, and equations to compare functions?</li> </ul>	

- How can you describe a relationship given a graph and sketch a graph given a description?
- How do you find the volume of a cylinder?
- How do you find the volume of a cone?
- How do you find the volume of a sphere?

## Objectives

### Students will know:

- Vocabulary related to functions in classroom discussions and assignments.
- Functions having a rule that assigns to each input exactly one output.
- Functions being used to model real life situations.
- Relations and functions being displayed as ordered pairs, in mapping diagrams, and on graphs.
- Functions being used to model real life situations.
- Vocabulary related to geometry in classroom discussions and assignments.
- Characteristics between three dimensional objects.
- The representation of two-dimensional figures can be used to understand the surfaces of three-dimensional objects.

### Students will be able to:

#### *Functions*

- Make connections between scenarios and the graphs that represent them.
- Write rules for producing outputs from inputs.
- Understand that a function has one and *only one* output for each allowable input.
- Identify rules that do and do not represent functions.
- Determine whether or not a graph represents a function, and explain the reasoning.
- Describe a context using function language (e.g., “The *output* is a function of the *input*” or “the *input* determines the *output*”).
- Represent a function with an equation.
- Identify independent and dependent variables.
- Interpret the graph of a function in context without an equation.
- Interpret points on the graph of a function.
- Understand that if the rate of change is positive over an interval, the function is increasing over that interval. If it is negative over an interval, the function is decreasing over that interval.
- Draw the graph of a function that represents a context.
- Understand that graphs representing the same context can appear different, depending on the variables chosen.
- Describe the strengths and weaknesses of different representations of functions.
- Compare inputs and outputs of functions that are represented in different ways.
- Use data points to model a linear function.
- Decide when it is reasonable or not to model a time series with a linear function.
- Approximate non-linear functions with piecewise linear functions.
- Calculate different rates of change of a piecewise linear function using a graph, and interpret rates of change in context.

#### *Volume*

- Recall the terms *cylinder*, *cone*, *cube*, and *sphere*.
- Estimate the volumes of various containers and explain the reasoning.
- Recognize that the volume of a cylinder is the area of the base times the height.
- Calculate the volumes of cylinders.

- Use representations of functions to analyze the relationship between one of a cylinder's dimensions and its volume
- Explain why the relationship between height and volume is linear but the relationship between radius and volume is non-linear.
- Recognize that the volume of a cone is one-third the volume of a cylinder with the same base and height.
- Develop and use a formula for the volume of a cone.
- Find one dimension of a cylinder or cone given its volume and another dimension.
- Notice how solving problems about the volume of a cone is similar to and different from solving problems about the volume of a cylinder.
- Reason about the volume of a hemisphere using the volume of the circumscribed cylinder and inscribed cone.
- Develop and use a formula for the volume of a sphere.

## Resources

**Core Text:**

<https://www.desmos.com/curriculum>

**Suggested Resources:**

Delta Math, Standardized Test Items, IXL,  
other internet and book-based resources



## Unit 6: Associations in Data

Summary and Rationale	
<p>Students analyze bivariate data. They use scatter plots and fitted lines to analyze numerical data and two-way tables and use bar graphs and segmented bar graphs to analyze categorical data. This unit builds on students' experience in earlier units with the coordinate plane and linear functions to focus on data in two variables. Students use scatter plots and fitted lines to analyze numerical data and identify associations. In high school, students will describe associations more precisely using correlation coefficients, and they will model bivariate data with nonlinear functions. Students use two-way tables, frequency tables, and segmented bar graphs to identify associations in categorical data. Students will continue to summarize categorical data and recognize associations or trends in data in high school.</p>	
Recommended Pacing	
17 - 19 days	
State Standards	
<b>Standard 8.SP Statistics and Probability</b>	
CPI #	Cumulative Progress Indicator (CPI)
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.
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 (e.g. line of best fit) by judging the closeness of the data points to the line.
3	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. <i>For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.</i>
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. <i>For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?</i>
Instructional Focus	
<b>Unit Enduring Understandings</b>	
<ul style="list-style-type: none"> <li>• Analyzing trends predict behavior.</li> <li>• Analysis of data assists in making informed decisions.</li> </ul>	
<b>Unit Essential Questions</b>	
<ul style="list-style-type: none"> <li>• Can understanding a relationship help make a prediction?</li> <li>• Why are relationships necessary?</li> </ul>	

- What is the best way to represent data?
- How can you construct and interpret scatter plots?
- How can you use a trend line to make a prediction from a scatter plot?
- How can you construct and interpret two-way frequency tables?
- How can categorical data be organized and analyzed?

### Objectives

#### Students will know:

- Vocabulary related to data (scatter plot, outlier, correlation, positive/negative/no association, two-way table, segmented bar graph, relative frequency)
- A variety of phenomena and relationships that can be modeled and analyzed using scatter plots
- Two-way frequencies by constructing and interpreting data
- Relative frequencies describe an association between the two variables

#### Students will be able to:

- Organize data in order to notice patterns
- Compare and contrast tables, scatter plots, dot plots, and other representations of the same data
- Create a scatter plot from a table of data
- Interpret points on a scatter plot in context
- Use a line of fit to predict values that are not given in the data
- Identify outliers on a scatter plot
- Describe whether data in a scatter plot has a positive, negative, or no association
- Interpret the slope of a line to data in context
- Determine if an association is linear or nonlinear, and explain the difference between linear and nonlinear in context
- Analyze clustering that appears in data using informal language, and explain what might cause clustering in context
- Create a scatter plot and draw a line to fit bivariate data, and identify outliers and clusters that appear in the data
- Determine associations between two variables to make predictions
- Identify and represent the same data in bar graphs and in two-way frequency tables
- Use relative frequencies displayed in tables and in segmented bar graphs to identify possible associations between variables
- Create a relative frequency table and a segmented bar graph that represents categorical data
- Use representations of categorical data to identify possible associations between variables

### Resources

#### Core Text:

<https://www.desmos.com/curriculum>

#### Suggested Resources:

Delta Math, Standardized Test Items, IXL, other internet and book-based resources

## Unit 7: Exponents and Scientific Notation

<b>Summary and Rationale</b>	
<p>This unit provides the opportunity for consistent practice in the topics of integer exponents and scientific notation. Students identify and create equivalent expressions involving positive, negative, and zero exponents. This builds on students' work with expressions involving positive whole number exponents in Grade 6. In future high school, students will investigate properties of non-integer exponents. Students will work to understand and apply the rules of exponents and magnitude of numbers with scientific notation.</p>	
<b>Recommended Pacing</b>	
19-21 days	
<b>State Standards</b>	
<b>Standard 8.EE Expressions and Equations</b>	
CPI #	Cumulative Progress Indicator (CPI)
1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = \frac{1^3}{3} = 1/27$
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. For example, estimate the population of the United States as $3 \times 10^8$ and the population of the world as $7 \times 10^9$ , and determine that the world population is more than 20 times larger.
4	Perform operations 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.
<b>Instructional Focus</b>	
<b>Unit Enduring Understandings</b>	
<ul style="list-style-type: none"> <li>• The symbolic language of algebra is used to communicate and generalize the patterns in mathematics.</li> <li>• One representation of a number may sometimes be more helpful than another.</li> <li>• Real-life situations can be translated and interpreted by algebraic sentences.</li> <li>• Relationships can be modeled in different forms.</li> </ul>	
<b>Unit Essential Questions</b>	
<ul style="list-style-type: none"> <li>• How can you develop and use the properties of integer exponents?</li> <li>• How can you use scientific notation to express very large and small quantities?</li> <li>• How do you add, subtract, multiply, and divide using scientific notation?</li> </ul>	
<b>Objectives</b>	
<b>Students will know:</b>	
<ul style="list-style-type: none"> <li>• Vocabulary related to expressions with integer exponents</li> <li>• The rules of exponents.</li> <li>• Scientific notation by writing, simplifying, and interpreting expressions.</li> </ul>	

**Students will be able to:**

- Review exponential notation
- Write exponential expressions to describe repeated multiplication
- Identify equivalent exponential expressions
- Write equivalent expressions involving the product of powers and powers of powers
- Justify that exponential expressions involving powers of powers and products of powers are equivalent
- Divide expressions involving exponents that have the same base
- Rewrite products of powers, quotients of powers, and powers of powers as single powers
- Determine if two expressions involving positive, zero, and negative exponents are equivalent
- Look for and generalize properties of exponents, including products of powers, quotients of powers, powers of powers, zero exponents, and negative exponents
- Begin to represent large and small numbers as multiples of powers of  $10$
- Represent large and small numbers as multiples of powers of  $10$  using number lines
- Apply powers of  $10$  and exponent rules to solve problems in context
- Distinguish expressions written in scientific notation from expressions that are not written in scientific notation
- Rewrite expressions using scientific notation
- Compare very large or very small numbers using scientific notation
- Multiply and divide numbers given in scientific notation to answer questions in context
- Add and subtract numbers in scientific notation to answer questions in context
- Use adding, subtracting, multiplying, and dividing with scientific notation to compare quantities and answer questions in context

**Resources****Core Text:**

<https://www.desmos.com/curriculum>

**Suggested Resources:**

Delta Math, Standardized Test Items, IXL, other internet and book-based resources

## Unit 8: The Pythagorean Theorem and Irrational Numbers

<b>Summary and Rationale</b>	
<p>This unit gives consistent practice in the topics of the Pythagorean Theorem and real numbers (rational and irrational). Students will work to understand the relationship between sides of a right triangle, calculating the distance between two points, and apply the definitions of rational and irrational numbers. Students represent square roots and cube roots as the edge lengths of squares and cubes and approximate their values. In future grades, students will use square and cube roots in more complex functions and in equations that use exponents. Students explore side lengths of right triangles using their knowledge of the areas of tilted squares. In high school, students use the Pythagorean theorem and other relationships to determine unknowns in right triangles. Students classify numbers as rational or irrational, revisiting square and cube roots. They also determine fractions and decimal approximations for rational numbers. In high school, students will investigate imaginary numbers.</p>	
<b>Recommended Pacing</b>	
20-22 days	
<b>State Standards</b>	
<b>Standard 8.NS The Number System</b>	
CPI #	Cumulative Progress Indicator (CPI)
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 eventually into a rational number.
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., $\pi^2$ ). For example, by truncating the decimal expansion of $\sqrt{2}$ , show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.
<b>Standard 8.EE Expressions and Equations</b>	
CPI #	Cumulative Progress Indicator (CPI)
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.
<b>Standard 8.G Geometry</b>	
CPI #	Cumulative Progress Indicator (CPI)
6	Explain a proof of the Pythagorean Theorem and its converse.
7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in realworld and mathematical problems in two and three dimensions.
8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

## Instructional Focus

### Unit Enduring Understandings

- Geometric relationships provide a means to make sense of a variety of phenomena
- One representation of a number may sometimes be more helpful than another.

### Unit Essential Questions

- How do spatial sense and geometric relationships help to make sense of phenomena?
- How can geometric relationships aid in understanding the real-world?
- How can you prove the Pythagorean Theorem and use it to solve problems?
- How can you test the converse of the Pythagorean Theorem and use it to solve problems?
- How can you use the Pythagorean Theorem to find the distance between two points on a coordinate plane?
- How do you rewrite rational numbers and decimals, take square roots and cube roots, and approximate irrational numbers?
- How can you describe relationships between sets of real numbers?
- How do you order a set of real numbers?

### Objectives

#### Students will know:

- Vocabulary related to proofs and the Pythagorean Theorem
- Mathematical proofs
- How and when to apply Pythagorean Theorem.
- The definition of rational and irrational numbers
- Fractions being another way to express division

#### Students will be able to:

- Recall how to calculate the area of a triangle
- Calculate the area of a square with vertices at the intersection of grid lines using strategies like “decompose and rearrange” and “surround and subtract.”
- Understand that the square root of a means the side length of a square whose area is a square units
- Use square root notation to represent the side length of a square given its area
- Approximate the value of a square root (e.g., by determining the two integer values it lies between or by drawing a square)
- Represent a square root as a point on a number line
- Identify the two whole number values that a square root is between and explain the reasoning
- Understand that the cube root of a means the side length of a cube whose volume is a cubic units
- Approximate the value of a cube root (e.g., by determining the two integer values it lies between or by drawing a cube)
- Describe patterns in the relationship between the squares of side lengths of a right triangle, and learn that this relationship is called the Pythagorean theorem
- Calculate unknown side lengths of a right triangle by using the Pythagorean theorem
- Determine whether a triangle with given side lengths is a right triangle using the converse of the Pythagorean theorem
- Use the Pythagorean theorem to solve problems within a context
- Calculate the distance between two points in the coordinate plane by using the Pythagorean theorem
- Develop a strategy for calculating the length of a diagonal line segment in the coordinate plane using the Pythagorean theorem
- Express a fraction as either a repeating or a terminating decimal
- Express a repeating decimal as a fraction
- Understand informally that every number has a decimal expansion
- Understand that rational numbers are defined as numbers that can be written as a fraction of two integers
- Understand that numbers that are not rational are called irrational, and that the square root of 2 is an example of an irrational number

## Resources

**Core Text:**

<https://www.desmos.com/curriculum>

**Suggested Resources:**

Delta Math, Standardized Test Items, IXL,  
other internet and book-based resources