

BERKELEY HEIGHTS PUBLIC SCHOOLS  
BERKELEY HEIGHTS, NEW JERSEY

**COLUMBIA MIDDLE SCHOOL  
MATHEMATICS DEPARTMENT**

**8<sup>TH</sup> GRADE MATHEMATICS**

**Curriculum Guide**

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**REVISED**

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This curriculum may be modified through varying techniques,  
strategies, and materials, as per an individual student's  
Individualized Educational Plan (IEP)

Approved by the Berkeley Heights Board of Education  
at the regular meeting held on 10/22/15.

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## **VISION STATEMENT**

Eighth Grade Mathematics focuses on three critical areas:

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;
2. Grasping the concept of a function and using functions to describe quantitative relationships;
3. Analyzing two and three-dimensional space and figures, using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

The course employs inductive and deductive approaches in the development of content. It promotes student communication, critical-thinking, and problem-solving through the refinement and extension of mathematical processes. Effective communication, using the language of mathematics, is essential for all math courses and will be emphasized throughout this course. The development of mathematical definitions, notation, terminology, syntax, and logic will be imbedded in the course studies. Students will be required to explain their solutions, using multiple representations in written/verbal, graphical, analytical and tabular formats.

## **MISSION STATEMENT**

Grade 8 Mathematics will move the students from the concepts developed in grades 6 and 7, modeling relationships with variables and equations and ratio and proportional reasoning, to making connections between proportional relationships, lines, and linear equations. The idea of a function introduced in grade 8 is a precursor to concepts about functions that are included in the high school standards. Each unit is comprised of standards that are considered major content along with standards that include supporting and/or additional content.

The concepts presented in unit 1 establish the groundwork for work with equations of lines. Unit 2 brings in the notion of irrational numbers which the students may encounter in their work with functions, expressions, and equations, which follow in units 3 and 4. Work in units 3 and 4 deepen students' understanding of algebraic concepts and provide foundational skills necessary for the standards presented in the high school level mathematics courses. Unit 5 will bring together the understanding of concepts that involve radicals and integer exponents with the Pythagorean Theorem.

National and state standards are aligned and integrated throughout the curriculum.

# **COURSE PROFICIENCIES**

## **COURSE OBJECTIVES**

### **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**

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

## STUDENT PROFICIENCIES

Some clusters that are not **major** emphases in themselves are designed to **support** and strengthen areas of major emphasis, while other clusters that may not connect tightly or explicitly to the major work of the grade would fairly be called **additional**. To say that some things have greater emphasis is not to say that anything in the standards can safely be neglected in instruction. Neglecting material will leave gaps in student skill and understanding and may leave students unprepared for the challenges of a later grade.

**Major Content** **Supporting Content** **Additional Content** (Identified by PARCC Model Content Frameworks).  
**Bold type indicates grade level fluency requirements.** (Identified by PARCC Model Content Frameworks).

The student will know or be able to:

### UNIT 1: Geometry

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING CCSS
<b>8u1-1</b>	Utilize the properties of rotation, reflection, and translation to model and relate pre-images of lines, line segments, and angles to their resultant image, through physical representations and/or Geometry software.	<b>8.G.1</b>
<b>8u1-2</b>	Apply an effective sequence of rotations, reflections, and translations to prove that two dimensional figures are congruent.	<b>8.G.2</b>
<b>8u1-3</b>	Use the coordinate plane to locate pre-images of two-dimensional figures and determine the coordinates of a resultant image, after applying dilations, rotations, reflections, and translations.	<b>8.G.3</b>
<b>8u1-4</b>	Recognize dilation as a reduction or an enlargement of a figure and determine the scale factor.	<b>8.G.3</b>
<b>8u1-5</b>	Apply an effective sequence of transformations to determine that figures are similar when corresponding angles are congruent and corresponding sides are proportional. Write similarity statements based on such transformations.	<b>8.G.4</b>
<b>8u1-6</b>	Justify facts about angles created when parallel lines are cut by a transversal.	<b>8.G.5</b>
<b>8u1-7</b>	Justify facts about the exterior angles of a triangle, the sum of the measures of the interior angles of a triangle, and the angle-angle relationship used to identify similar triangles.	<b>8.G.5</b>

## UNIT 2: The Number System

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING CCSS
8u2-1	Compare rational and irrational numbers, to demonstrate that the decimal expansion of irrational numbers do not repeat; show that every rational number has a decimal expansion, which eventually repeats and convert such decimals into rational numbers.	8.NS.1
8u2-2	Use rational numbers to approximate and locate irrational numbers on a number line and estimate the value of expressions involving irrational numbers.	8.NS.2
8u2-3	Apply the properties of integer exponents, to simplify and write equivalent numerical expressions.	8.EE.1
8u2-4	Use scientific notation to estimate and express the values of very large or very small numbers and compare their values (how many times larger/smaller is one than the other).	8.EE.3
8u2-5	Perform operations using numbers expressed in scientific notation, including problems where both decimals and scientific notation are used (interpret scientific notation generated when technology has been used for calculations).	8.EE.4
8u2-6	In real-world problem-solving situations choose units of appropriate size, for measurement of very small and very large quantities.	8.EE.4

## UNIT 3: Equations

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING CCSS
8u3-1	Graph and analyze the different representations of proportional relationships and interpret the unit rate as the slope of the graph, which indicates the rate of change.	8.EE.5
8u3-2	Derive the equation of a line ( $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$ ) and use similar triangles to explain why the slope ( $m$ ) is the same between any two points on a non-vertical line in the coordinate plane.	8.EE.6
8u3-3	Solve linear equations in one variable with rational number coefficients that might require expanding expressions, using the distributive property and/or combining like terms, including examples with one solution, infinite solutions, or no solution.	8.EE.7
8u3-4	Solve systems of linear equations in two variables by inspection, algebraically, and/or graphically (estimate solutions), to demonstrate solutions correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.	8.EE.8
8u3-5	Construct a function to model the linear relationship between two variables and determine the rate of change and initial value of the real world data it represents, from either graphs or tabulated values.	8.F.4
8u3-6	Sketch a graph of a function from a qualitative description and give a qualitative description of a graph of a function.	8.F.5

### UNIT 4: Functions and Geometry

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING CCSS
<b>8u4-1</b>	Define functions as a rule that assigns one output to each input and determine if data represented, as a graph or in a table, is a function.	<b>8.F.1</b>
<b>8u4-2</b>	Compare two functions each represented in a different way (numerically, verbally, graphically, and algebraically) and draw conclusions about their properties (rate of change and intercepts).	<b>8.F.2</b>
<b>8u4-3</b>	Utilize equations, graphs, and tables to classify functions as linear or non-linear, recognizing that $y = mx + b$ is linear with a constant rate of change.	<b>8.F.3</b>
<b>8u4-4</b>	Evaluate square roots and cubic roots of small perfect squares and cubes respectively and use square 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. Identify $\sqrt{2}$ as irrational.	<b>8.EE.2</b>
<b>8u4-5</b>	Explain a proof of the Pythagorean Theorem and its converse.	<b>8.G.6</b>
<b>8u4-6</b>	Utilize the Pythagorean Theorem to determine unknown side lengths of right triangles in two and three dimensions, to solve real-world and mathematical problems	<b>8.G.7</b>
<b>8u4-7</b>	Use the Pythagorean Theorem to determine the distance between two points in the coordinate plane.	<b>8.G.8</b>

### UNIT 5: Statistics and Geometry

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING CCSS
<b>8u5-1</b>	Using a linear equation to model real life problems then solve it by interpreting the meaning of the slope and the intercept.	<b>8.SP.3</b>
<b>8u5-2</b>	Construct and interpret scatter plots for bivariate measurement data and identify and interpret data patterns (clustering, outliers, positive or negative association, possible lines of best fit, and nonlinear association).	<b>8.SP.1</b> <b>8.SP.2</b>
<b>8u5-3</b>	Construct frequency/relative frequency tables to analyze and describe possible associations between two variables.	<b>8.SP.4</b>
<b>8u5-4</b>	Know and apply the appropriate formula for the volume of a cone, a cylinder, or a sphere to solve real-world and mathematical problems.	<b>8.G.9</b>

## **METHODS OF EVALUATION**

1. Projects/reports/presentations.
2. Laboratory activities.
3. Simulated activities.
4. Classroom participation and cooperation.
5. Performance on worksheets, quizzes, and unit tests.
6. Final exam, projects, and/or reports.

**SCOPE AND SEQUENCE**  
**COURSE OUTLINE/STUDENT OBJECTIVE**

**The student will be able to:**

**Unit 1: Geometry (5 weeks Instruction / 2 weeks Assessment/Enrichment)**

Understand congruence and similarity using physical models, transparencies, or geometry software.	<b>8.G.1</b>	Verify experimentally the properties of rotations, reflections, and translations: <ul style="list-style-type: none"> <li>a. Lines are taken to lines, and line segments to line segments of the same length.</li> <li>b. Angles are taken to angles of the same measure.</li> <li>c. Parallel lines are taken to parallel lines.</li> </ul>
	<b>8.G.2</b>	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.
	<b>8.G.3</b>	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
	<b>8.G.4</b>	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.
	<b>8.G.5</b>	Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange 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.

**Unit 2: The Number System (5 weeks Instruction / 2 weeks Assessment/Enrichment)**

Know that there are numbers that are not rational, and approximate them by rational numbers.	8.NS.1	Know that other numbers are called irrational. Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat.
	8.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., $\pi^2$ ). 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.
Expressions and Equations Work with radicals and integer exponents.	8.EE.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^5 = 3^7 = 1/3^2 = 1/27$ .
	8.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. 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.
	8.EE.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.

### Unit 3: Equations (5 weeks Instruction / 2 weeks Assessment/Enrichment)

Understand the connections between proportional relationships, lines, and linear equations.	8.EE.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.
	8.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 $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$ .
Analyze and solve linear equations and pairs of simultaneous linear equations.	8.EE.7	Solve linear equations in one variable. <ul style="list-style-type: none"> <li>a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form <math>x = a</math>, <math>a = a</math>, or <math>a = b</math> results (where <math>a</math> and <math>b</math> are different numbers).</li> <li>b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</li> </ul>
	8.EE.8	Analyze and solve pairs of simultaneous linear equations. <ul style="list-style-type: none"> <li>a. 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.</li> <li>b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, equations <math>3x + 2y = 5</math> and <math>3x + 2y = 6</math> have no solution because <math>3x + 2y</math> cannot simultaneously be 5 and 6.</li> <li>c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.</li> </ul>
Use functions to model relationships between quantities.	8.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 $(x, y)$ 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.
	8.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.

**Unit 4: Functions and Geometry (5 weeks Instruction / 2 weeks Assessment/Enrichment)**

Define, evaluate, and compare functions.	<b>8.F.1</b>	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.
	<b>8.F.2</b>	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
	<b>8.F.3</b>	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.
Understand and apply the Pythagorean Theorem.	<b>8.G.6</b>	Explain a proof of the Pythagorean Theorem and its converse.
	<b>8.G.7</b>	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
	<b>8.G.8</b>	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

**Unit 5: Statistics and Geometry (5 weeks Instruction / 2 weeks Assessment/Enrichment)**

Investigate patterns of association in bivariate data.	<b>8.SP.3</b>	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. 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.
	<b>8.SP.1</b>	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.
	<b>8.SP.2</b>	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.
	<b>8.SP.4</b>	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. 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?
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	<b>8.G.9</b>	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

## **RESOURCES/ACTIVITIES GUIDE**

Carter, John A., Gilbert J. Cuevas, Roger Day, and Carol E. Malloy. *Glencoe Math: Built to the Common Core Course 3 Volume 1 & 2*. Bothell, WA: Glencoe/McGraw-Hill, 2015.

*Common Core State Standards*. S.I.: J Weston Walch Pub, 2011. *Corestandards.org*. Web. 24 June 2015. <[http://www.corestandards.org/wp-content/uploads/Math\\_Standards.pdf](http://www.corestandards.org/wp-content/uploads/Math_Standards.pdf)>.

NJDOE. "Model Curriculum: Mathematics (K-12) - Mathematics Grade 8 Overview." *NJ State Department of Education*. N.p., 2013. Web. 24 June 2015. <<http://www.state.nj.us/education/modelcurriculum/math/8.shtml>>.

Glencoe Math: Built to the Common Core. Course 2. Electronic Text  
Activities and videos providing instant self-check, tutorial, and activities  
Reading support with audio  
Instant feedback assessments  
Practice workbook  
Guided Problem Solving Masters  
Hands-On Activities  
Technology Activities  
Examples/Quiz Transparencies  
Test Generator

## RESOURCES/ACTIVITIES GUIDE

### **Selected Opportunities for Connection to Mathematical Practices**

1. Make sense of problems and persevere in solving them.  
8u2-6 Use problems that describe complex real-world conditions.  
8u5-4 Involve problems that must be constructed and deconstructed in order to solve.
2. Reason abstractly and quantitatively.  
8u3-1 Describe the relationship between the slope of a graph and the rate of change in proportional relationships.  
8u4-2 Use functions that are represented in different ways to identify and compare the rates of change and the intercepts of each.
3. Construct viable arguments and critique the reasoning of others.  
8u3-3 and 8u3-4 Determine and justify the steps to the solution to equations.
4. Model with mathematics.  
8u3-6 Create a graph from a description of a real-world condition and give a real-world context for a graphic display.  
8u4-1, 8u4-2 and 8u4-3 Use equations, scatter plots, and frequency tables to model relationships between real world quantities.  
8u5-1, 8u5-2, 8u5-3 Use equations, scatter plots, and frequency tables to model relationships between real-world quantities.
5. Use appropriate tools strategically.
6. Attend to precision.  
8u2-6 Determine appropriate sized units for a given context.
7. Look for and make use of structure.  
8u2-3 Examine the form of expressions involving integer exponents and apply the correct property of exponents to create equivalent expressions.  
8u4-2 Identify the rate of change and the intercepts of functions represented in different ways.
8. Look for and express regularity in repeated reasoning.  
8u2-1 Explain orally or in written language the difference between a rational and an irrational number.

*All of the content presented at this grade level has connections to the standards for mathematical practices.*

## **SUGGESTED AUDIO VISUAL/COMPUTER AIDS**

1. Texas Instruments TI-34II scientific and TI-84+ graphing calculator.

2. Lesson and help websites:

<http://www.khanacademy.org/>

<http://www.coolmath.com/prealgebra>

<http://www.webmath.com/index4.html>

<http://www.thatquiz.org/>

<http://www.ck-12.org/>

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

3. Manipulatives. (Algebra tiles, geometric figures, tangrams, etc.)

4. Internet support from publisher: <http://connected.mcgraw-hill.com/> provides interactive text online with activities and videos.

## **SUGGESTED MATERIALS**

### **Resources for Students**

Carter, John A., Gilbert J. Cuevas, Roger Day, and Carol E. Malloy. *Glencoe Math: Built to the Common Core Course 3 Volume 1 & 2*. Bothell, WA: Glencoe/McGraw-Hill, 2015.

Glencoe Math Hands-On Activities.

<https://www.khanacademy.org/mission/cc-seventh-grade-math>

Scientific Calculator.

### **Resources for Teacher**

Carter, John A., Gilbert J. Cuevas, Roger Day, and Carol E. Malloy. *Glencoe Math: Built to the Common Core Course 3 Volume 1 & 2*. Bothell, WA: Glencoe/McGraw-Hill, 2015.

Glencoe Math Teacher Center

(Check, eHelp eSolutions, Tools, Tutor, Vocab, Watch, Worksheets, Presentations)

Manipulatives

CK-12.ORG