

Mathematics Scope and Sequence – Middle School Grade 8

Standards

NCTM Curriculum Focal Points

The National Council of Teachers of Mathematics (NCTM) created its *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics* (2006) to provide descriptions of the most significant mathematical concepts and skills at each grade level. These focal points were chosen according to three criteria: they are mathematically important, both for further study in mathematics and for use in applications in and outside of school; they conform to what is known about learning mathematics; they connect logically with the mathematics in earlier and later grade levels. According to the NCTM, “these curriculum focal points should be considered as major instructional goals and desirable learning expectations, not as a list of objectives for students to master.” It is important that none of the focal points be omitted; it is less important whether they are addressed a year earlier or later, or over a period of two years, compared with the suggested sequence in the document. On this page, each of the NCTM focal points is followed (in parentheses) by the corresponding New York State performance indicators.

Focal Points

***Algebra:* Analyzing and representing linear functions and solving linear equations and systems of linear equations**

Students use linear functions, linear equations, and systems of linear equations to represent, analyze, and solve a variety of problems. They recognize a proportion ($y/x = k$, or $y = kx$) as a special case of a linear equation of the form $y = mx + b$, understanding that the constant of proportionality (k) is the slope and the resulting graph is a line through the origin. Students understand that the slope (m) of a line is a constant rate of change, so if the input, or x -coordinate, changes by a specific amount, a , the output, or y -coordinate, changes by the amount ma . Students translate among verbal, tabular, graphical, and algebraic representations of functions (recognizing that tabular and graphical representations are usually only partial representations), and they describe how such aspects of a function as slope and y -intercept appear in different representations. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines that intersect, are parallel, or are the same line, in the plane. Students use linear equations, systems of linear equations, linear functions, and their understanding of the slope of a line to analyze situations and solve problems. (7.A.7-8, 7.A.10)

***Geometry and Measurement:* Analyzing two- and three-dimensional space and figures by using distance and angle**

Students use fundamental facts about distance and angles to describe and analyze figures and situations in two- and three-dimensional space and to solve problems, including those with multiple steps. They prove that particular configurations of lines give rise to similar triangles because of the congruent angles created when a transversal cuts parallel lines. Students apply this reasoning about similar triangles to solve a variety of problems, including those that ask them to find heights and distances. They use facts about the angles that are created when a transversal cuts parallel lines to explain why the sum of the measures of the angles in a triangle is 180 degrees, and they apply this fact about triangles to find unknown measures of angles. Students explain why the Pythagorean theorem is valid by using a variety of methods—for example, by decomposing a square in two different ways. They apply the Pythagorean theorem to find distances between points in the Cartesian coordinate plane to measure lengths and analyze polygons and polyhedra. (5.G.7-8, 7.G.5-9)

***Data Analysis and Number Sense and Operations and Algebra:* Analyzing and summarizing data sets**

Students use descriptive statistics, including mean, median, and range, to summarize and compare data sets, and they organize and display data to pose and answer questions. They compare the information provided by the mean and the median and investigate the different effects that changes in data values have on these measures of center. They understand that a measure of center alone does not thoroughly describe a data set because very different data sets can share the same measure of center. Students select the mean or the median as the appropriate measure of center for a given purpose. (6.S.2, 6.S.4-8, 7.S.1-6)

Connections to the Focal Points

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Algebra: Students encounter some nonlinear functions (such as the inverse proportions that they studied in grade 7 as well as basic quadratic and exponential functions) whose rates of change contrast with the constant rate of change of linear functions. They view arithmetic sequences, including those arising from patterns or problems, as linear functions whose inputs are counting numbers. They apply ideas about linear functions to solve problems involving rates such as motion at a constant speed.

Geometry: Given a line in a coordinate plane, students understand that all “slope triangles”—triangles created by a vertical “rise” line segment (showing the change in y), a horizontal “run” line segment (showing the change in x), and a segment of the line itself—are similar. They also understand the relationship of these similar triangles to the constant slope of a line.

Data Analysis: Building on their work in previous grades to organize and display data to pose and answer questions, students now see numerical data as an aggregate, which they can often summarize with one or several numbers. In addition to the median, students determine the 25th and 75th percentiles (1st and 3rd quartiles) to obtain information about the spread of data. They may use box-and-whisker plots to convey this information. Students make scatterplots to display bivariate data, and they informally estimate lines of best fit to make and test conjectures.

Number Sense and Operations: Students use exponents and scientific notation to describe very large and very small numbers. They use square roots when they apply the Pythagorean theorem.

Academic Language

Grade 8 Mathematical Language

Math vocabulary which students at this grade are expected to master and use: <http://www.emsc.nysed.gov/3-8/mathlang.doc>

PreK-8 Glossary of Mathematical Terms

Definitions of mathematical terms used in elementary and middle school: <http://www.emsc.nysed.gov/3-8/pk-8glossary.doc>

Lesson Planning

Daily planning guide keyed to the standard curriculum for this grade: http://glencoe.com/sites/common_assets/mathematics/im1/mathematics_planning/Grade8.doc

Development of Content Topics and Concepts

For each content strand these documents trace the development year by year of every band (i.e., sub-skill) from elementary school through high school. As such they provide insight into the foundational work done in previous grades and map the subsequent elaboration of the topics in later courses.

Band Traces:

Number Sense and Operations: <http://schools.nyc.gov/NR/ronlyres/4C837772-3E02-4552-A02E-AE7E9AE769C1/47718/StrandTraceNumberSenseandOperations.pdf>

Algebra: <http://schools.nyc.gov/NR/ronlyres/4C837772-3E02-4552-A02E-AE7E9AE769C1/47719/StrandTraceAlgebra.pdf>

Geometry: <http://schools.nyc.gov/NR/ronlyres/4C837772-3E02-4552-A02E-AE7E9AE769C1/47720/StrandTraceGeometry.pdf>

Measurement: <http://schools.nyc.gov/NR/ronlyres/4C837772-3E02-4552-A02E-AE7E9AE769C1/47721/StrandTraceMeasurement.pdf>

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Statistics and Probability: <http://schools.nyc.gov/NR/ronlyres/4C837772-3E02-4552-A02E-AE7E9AE769C1/47722/StrandTraceStatisticsandProbability.pdf>

Development of Content Topics and Concepts (continued)

The chart below depicts the number of performance indicators for the content strands by grade level. The emphasis in grades Pre-Kindergarten-4 is on Number Sense and Operations. Algebra builds slowly beginning with patterns in the early elementary grades and leads up to relations and functions in grade 8. Geometry builds as well with a heavy emphasis in the grades 5-8. Measurement increases significantly across the grades with the exception of grade 8. Statistics includes the collection and display of data in the early elementary grades and probability is introduced in grade 5.

Number of Content Performance Indicators by Grade Level											
Content Strand	Pre-K	K	1	2	3	4	5	6	7	8	TOTAL
Number Sense and Operations	9	13	30	22	27	27	27	27	19	6	207
Algebra	1	2	1	2	2	5	8	6	10	19	56
Geometry	2	5	5	6	5	8	14	11	10	21	87
Measurement	2	3	11	10	10	10	11	9	13	1	80
Statistics and Probability	4	5	9	5	8	6	7	11	12	0	67
TOTAL	18	28	56	45	52	56	67	64	64	47	497

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Assessment

Approximate Percentage of Questions Assessing Each Strand

The questions on the Grades 3–8 Mathematics Tests assess both the content and the process strands of New York State Mathematics Standard 3. Each question is aligned to one content performance indicator, for reporting purposes, but is also aligned to one or more process performance indicators, as appropriate for the concepts embodied in the task. As a result of the alignment to both process and content strands, the tests assess students' conceptual understanding, procedural fluency, and problem-solving abilities rather than assessing knowledge of isolated skills and facts.

Strand	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
1 Number Sense and Operations	48%	45%	39%	37%	30%	11%
2 Algebra	13%	14%	11%	19%	12%	44%
3 Geometry	13%	12%	25%	17%	14%	35%
4 Measurement	13%	17%	14%	11%	14%	10%
5 Probability and Statistics	13%	12%	11%	16%	30%	0%

For the most recent Grade 8 exam, Book 1 can be downloaded at : <http://www.nysedregents.org/testing/mathe/08exams/m8bk1.pdf>
and Book 2 at: <http://www.nysedregents.org/testing/mathe/08exams/m8bk2.pdf>

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Calculator Policy

Listed below are the courses in grades 7-12 that require access to calculators, and the specific calculator(s) that may be used on the assessment. More than providing access on the day of the exam, schools must ensure that students possess facility in the use of these calculators. Therefore teachers should integrate their regular use as part of the year’s coursework.

Course		4- Function Calculator		Scientific Calculator		Graphing Calculator
7 th Grade Math	Required	no		yes		no
8 th Grade Math	Required	no		yes		no
Math A	Required	no		yes	OR	yes
Math B	Required	no		no		yes
Integrated Algebra	Required	no		no		yes
Geometry	Required	no		no		yes
AP Calculus	Required	no		no		yes
AP Statistics	Required	no		no		yes
PSAT	Required	yes	OR	yes	OR	yes

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Selected Internet Websites - Grade Eight

These on-line resources can serve to reinforce student mathematical skills and concepts, and to help teachers differentiate their mathematics instruction.

STRAND	TOPIC	WEBSITE
Algebra	Solving Linear Equations and Systems of Linear Equations	http://www.studygs.net/equations.htm http://www.sosmath.com/algebra/solve/solve0/solve0.html http://cs.jsu.edu/mcis/faculty/leathrum/Mathlets/linear.html#instr
Geometry & Measurement	Analyzing two-and three-dimensional space using distance and angle	http://standards.nctm.org/document/eexamples/chap6/6.5/index.htm#applet http://www.1728.com/distance.htm http://www.mathnstuff.com/math/spoken/here/2class/260/trans.htm http://www.stmarysrosebank.org/school/uploads/forms/PARALLEL%20LINES%20CUT%20BY%20A%20TRANSVERSAL.687344.ppt#270,15,TRY IT OUT
Data Analysis	Analyzing and Summarizing Data	http://illuminations.nctm.org/Activities.aspx?grade=all&srchstr=data http://www.aaamath.com/grade8.html#topic202

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NUMBER SENSE AND OPERATIONS STRAND	<p style="text-align: center;"><i>Operations</i></p> <p>8.N.3 Read, write, and identify percents less than 1% and greater than 100%</p> <p>8.N.4 Apply percents to: Tax, percent increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</p> <p style="text-align: center;"><i>Estimation</i></p> <p>8.N.6 Justify the reasonableness of answers using estimation</p>	<p style="text-align: center;"><i>Operations</i></p> <p>8.N.1 Develop and apply the laws of exponents for multiplication and division</p> <p>8.N.2 Evaluate expressions with integral exponents</p> <p>8.N. 3 Read, write, and identify percents less than 1% and greater than 100%</p> <p>8.N.4 Apply percents to: Tax, percent increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</p> <p style="text-align: center;"><i>Estimation</i></p> <p>8.N.6 Justify the reasonableness of answers using estimation</p>	<p style="text-align: center;"><i>Operations</i></p> <p>8.N.4 Apply percents to: Tax, percent increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</p> <p style="text-align: center;"><i>Estimation</i></p> <p>8.N.5 Estimate a percent of a quantity, given an application</p>	

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ALGEBRA STRAND	<p style="text-align: center;"><i>Variables and Expressions</i></p> <p>8.A.3 Describe a situation involving relationships that matches a given graph</p> <p>8.A.4 Create a graph given a description or an expression for a situation involving a linear or nonlinear relationship</p> <p style="text-align: center;"><i>Patterns, Relations and Functions</i></p> <p>8.A.15 Understand that numerical information can be represented in multiple ways: arithmetically, algebraically and graphically</p> <p>8.A.16 Find sets of ordered pairs to satisfy an algebraic expression and then plot the ordered pairs and draw the line</p>	<p style="text-align: center;"><i>Variables and Expressions</i></p> <p>8.A.5 Use physical models to perform operations with polynomials (uses area of rectangles as a way to think about the distributive property)</p> <p>8.A.6 Multiply and divide monomials</p> <p>8.A.7 Add and subtract polynomials (integer coefficients)</p> <p>8.A.8 Multiply a binomial by a monomial or binomial (integer coefficients)</p> <p>8.A.9 Divide a polynomial by a monomial (integer coefficients)</p> <p style="text-align: center;"><i>Equations and Inequalities</i></p> <p>8.A.12 Apply algebra to determine the measure of angles formed by or contained in parallel lines cut by a transversal and by intersecting lines</p>	<p style="text-align: center;"><i>Variables and Expressions</i></p> <p>8.A.1 Translate verbal sentences into algebraic inequalities</p> <p>8.A.2 Write verbal expressions that match given mathematical expressions</p> <p>8.A.3 Describe a situation involving relationships that matches a given graph</p> <p>8.A.5 Use physical models to perform operations with polynomials</p> <p>8.A.10 Factor algebraic expressions using the GCF</p> <p>8.A.11 Factor a trinomial in the form ax^2+bx+c; $a=1$ and c having no more than 3 sets of factors</p> <p style="text-align: center;"><i>Equations and Inequalities</i></p> <p>8.A.13 Solve multi-step inequalities and graph the solution set on a number line</p> <p>8.A.14 Solve linear inequalities by combining like terms, using the distributive property, or moving variables to one side of the inequality (include multiplication or division of inequalities by a negative number)</p> <p style="text-align: center;"><i>Patterns, Relations and Functions</i></p> <p>8.A.15 Understand that numerical information can be represented in multiple ways: arithmetically, algebraically and graphically</p>	<p style="text-align: center;"><i>Patterns, Relations and Functions</i></p> <p>8.A.17 Define and use correct terminology when referring to function (domain and range)</p> <p>8.A.18 Determine if a relation is a function</p> <p>8.A.19* Interpret multiple representations using equation, table of values and graph</p>

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GEOMETRY STRAND	<p style="text-align: center;"><i>Geometric Relationships</i></p> <p>8.G.1 Identify pairs of vertical angles as congruent</p> <p>8.G.2 Identify pairs of supplementary and complementary angles</p> <p>8.G.3 Calculate the missing angle in a supplementary or complementary pair</p> <p>8.G.4 Determine angle pair relationship when given two parallel lines cut by a transversal</p> <p>8.G.5 Calculate the missing angle measurements when given two parallel lines cut by a transversal</p> <p>8.G.6 Calculate the missing angle measurements when given two intersecting lines and an angle</p> <p style="text-align: center;"><i>Coordinate Geometry</i></p> <p>8.G.13 Determine the slope of a line from a graph and explain the meaning of slope as a constant rate of change</p> <p>8.G.14 Determine the y-intercept of a line from a graph and be able to explain the y-intercept</p> <p>8.G.15 Graph a line using a table of values</p> <p>8.G.16 Determine the equation of a line given the slope and the y-intercept</p> <p>8.G.17 Graph a line from an equation in slope-intercept form ($y = mx + b$)</p>		<p style="text-align: center;"><i>Transformational Geometry</i></p> <p>8.G.7 Describe and identify transformations in the plane, using proper function notation (rotations, reflections, translations, and dilations.)</p> <p>8.G.8 Draw the image of a figure under rotations of 90 and 180 degrees</p> <p>8.G.9 Draw the image of a figure under a reflection over a given line</p> <p>8.G.10 Draw the image of a figure under a translation</p> <p>8.G.11 Draw the image of a figure under a dilation</p> <p>8.G.12 Identify the properties preserved and not preserved under a reflection, rotation, translation, and dilation</p> <p style="text-align: center;"><i>Coordinate Geometry</i></p> <p>8.G.18 Solve systems of equations graphically (only linear, integral solutions, $y = mx + b$ format, no vertical or horizontal lines)</p> <p>8.G.19 Graph the solution set of an inequality on a number line</p> <p>8.G.20 Distinguish between linear and nonlinear equations $ax^2 + bx + c$; $a = 1$ (only graphically)</p> <p>8.G.21 Recognize the characteristics of quadratics in tables, graphs, equations, and situations</p>	<p>8.G.0*Construct the following using a straight edge and compass: Segment congruent to a segment; angle congruent to an angle; perpendicular bisector, and angle bisector</p> <p style="text-align: center;"><i>Coordinate Geometry</i></p> <p>8.G.20 Distinguish between linear and nonlinear equations $ax^2 + bx + c$; $a = 1$ (only graphically)</p> <p>8.G.21 Recognize the characteristics of quadratics in tables, graphs, equations, and situations</p>

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MEASUREMENT STRAND			<p style="text-align: center;"><i>Units of Measurement</i></p> <p>8.M.1 Solve equations/ proportions to convert to equivalent measurements within metric and customary measurement systems.</p>	

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