

# Mathematics Scope and Sequence – High School Integrated Algebra

## **Standards**

### **NCTM Principles and Standards**

The National Council of Teachers of Mathematics (NCTM) created its *Principles and Standards for School Mathematics* in 2004. From the introduction to Grades 9–12: “These Standards describe an ambitious foundation of mathematical ideas and applications intended for all students. Through its emphasis on fundamental mathematical concepts and essential skills, this foundation would give all students solid preparation for work and citizenship, positive mathematical dispositions, and the conceptual basis for further study... Through their high school experiences, they stand to develop deeper understandings of the fundamental mathematical concepts of function and relation, invariance, and transformation.

In high school, students should build on their prior knowledge, learning more-varied and more-sophisticated problem-solving techniques. They should increase their abilities to visualize, describe, and analyze situations in mathematical terms. They need to learn to use a wide range of explicitly- and recursively-defined functions to model the world around them. Moreover, their understanding of the properties of those functions will give them insights into the phenomena being modeled. Secondary school students need to develop increased abilities in justifying claims, proving conjectures, and using symbols in reasoning. They can be expected to learn to provide carefully reasoned arguments in support of their claims. They can practice making and interpreting oral and written claims so that they can communicate effectively while working with others and can convey the results of their work with clarity and power. They should continue to develop facility with such technological tools as spreadsheets, data-gathering devices, computer algebra systems, and graphing utilities that enable them to solve problems that would require large amounts of computational time if done by hand.

A central theme of *Principles and Standards for School Mathematics* is connections. Students develop a much richer understanding of mathematics and its applications when they can view the same phenomena from multiple mathematical perspectives. One way to have students see mathematics in this way is to use instructional materials that are intentionally designed to weave together different content strands. Another means of achieving content integration is to make sure that courses oriented toward any particular content area (such as algebra or geometry) contain many integrative problems—problems that draw on a variety of aspects of mathematics, that are solvable using a variety of methods, and that students can access in different ways.

These Standards are demanding. It will take time, patience, and skill to implement the vision they represent... Such efforts are essential. We owe our children no less than a high degree of quantitative literacy and mathematical knowledge that prepares them for citizenship, work, and further study.”

## **Algebra Expectations**

### **Understand patterns, relations, and functions**

Students generalize patterns using explicitly-defined and recursively-defined functions and can understand relations and functions and select, convert flexibly among, and use various representations for them. They analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior. Students understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions. Students understand and compare the properties of classes of functions, including exponential, polynomial, rational, logarithmic, and periodic functions and they can interpret representations of functions of two variables

### **Represent and analyze mathematical situations and structures using algebraic symbols**

Students understand the meaning of equivalent forms of expressions, equations, inequalities, and relations and can write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases. They use symbolic algebra to represent and explain mathematical relationships and use a variety of symbolic representations, including recursive and parametric equations, for functions and relations. Students judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology.

### **Use mathematical models to represent and understand quantitative relationships**

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# Mathematics Scope and Sequence – High School

## Integrated Algebra

Students identify essential quantitative relationships in a situation and determine the class or classes of functions that might model the relationships. They use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts and can draw reasonable conclusions about a situation being modeled.

### **Analyze change in various contexts**

Students approximate and interpret rates of change from graphical and numerical data.

## **Academic Language**

### Integrated Algebra Mathematical Language

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

### Commencement-Level Glossary of Mathematical Terms

Definitions of mathematical terms used in high school: <http://www.emsc.nysed.gov/3-8/glossaryHS.doc>

## **Lesson Planning**

Daily planning guide keyed to the standard curriculum (two semesters) for this grade:

[http://schools.nycenet.edu/offices/teachlearn/mathematics/Integrated\\_Algebra\\_TwoSemester\\_Planning.pdf](http://schools.nycenet.edu/offices/teachlearn/mathematics/Integrated_Algebra_TwoSemester_Planning.pdf)

## **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>

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

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### Development of Content Topics and Concepts (continued)

The chart below depicts the number of performance indicators for the content strands of each course. It's important to note that the numbers refer to the **new** performance indicators introduced in each course; performance indicators from previous courses (and grade levels) are assumed to have been incorporated into students' repertory of skills and abilities. For example the Geometry course makes extensive use of algebraic concepts and procedures learned in the previous course, in order to solve geometric problems. However no new algebra topics are introduced in the geometry course.

<b>Number of Performance Indicators for Each Course</b>				
<i>Content Strand</i>	<i>Integrated Algebra</i>	<i>Geometry</i>	<i>Algebra 2 and Trigonometry</i>	<i>Total</i>
<b>Number Sense and Operations</b>	8	0	10	<b>18</b>
<b>Algebra</b>	45	0	77	<b>122</b>
<b>Geometry</b>	10	74	0	<b>84</b>
<b>Measurement</b>	3	0	2	<b>5</b>
<b>Statistics and Probability</b>	23	0	16	<b>39</b>
<b>TOTAL</b>	<b>89</b>	<b>74</b>	<b>105</b>	<b>268</b>

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### Assessment

#### **Approximate Percentage of Questions Assessing Each Strand**

The questions on the Integrated Algebra Regents Exam assess both the content and the process strands of New York State Mathematics Standard 3. Each question is aligned to at least one content performance indicator, 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.

<b>Content Strand</b>	<b>% of Total Credits</b>
1. Number Sense and Operations	6 - 10 %
2. Algebra	50 - 55 %
3. Geometry	14 - 19 %
4. Measurement	3 - 8 %
5. Probability and Statistics	14 - 19 %

Previous Integrated Algebra Regents Exams can be downloaded at: [http://www.jmap.org/JMAP\\_REGENTS\\_EXAMS.htm](http://www.jmap.org/JMAP_REGENTS_EXAMS.htm)

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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 <sup>th</sup> Grade Math	Required	no		yes		no
8 <sup>th</sup> Grade Math	Required	no		yes		no
Math A	Required	no		yes	<b>OR</b>	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	<b>OR</b>	yes	<b>OR</b>	yes

## Mathematics Scope and Sequence – High School Integrated Algebra

### Selected Internet Websites - Integrated Algebra

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	Patterns, Relations, and Functions	<a href="http://www.askkids.com/resource/Relations-and-Functions-in-Algebra.html">http://www.askkids.com/resource/Relations-and-Functions-in-Algebra.html</a> <a href="http://tech.bcschools.net/curriculum/maser/math/hpatterns.htm">http://tech.bcschools.net/curriculum/maser/math/hpatterns.htm</a>
Algebra	Understanding Equivalent forms of Expressions, Equations, Inequalities, and Relations	<a href="http://www.mathslideshow.com/Alg1PH/previews.htm">http://www.mathslideshow.com/Alg1PH/previews.htm</a> <a href="http://www.norris160.org/vogt/Algebra1/PowerPoint%20Chapters.htm">http://www.norris160.org/vogt/Algebra1/PowerPoint%20Chapters.htm</a>
Algebra	Understanding Rates of Change	<a href="http://tech.bcschools.net/curriculum/maser/math/hvc.htm">http://tech.bcschools.net/curriculum/maser/math/hvc.htm</a>

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	<b>September / October</b>	<b>October / November</b>	<b>December / January</b>
<b>Number Sense and Operations Strand</b>	<p><i>Unit 1 - Number Properties, Operations, Data and Statistics, Probability Number Theory</i></p> <p>A.N.1 Identify and apply the properties of real numbers (closure, commutative, associative, distributive, identity, inverse)</p> <p>A.N.6 Evaluate expressions involving factorial(s), absolute value(s), and exponential expression(s)</p>	<p><i>Unit 2 - Solving Equations and Inequalities</i></p> <p>A.N.1 Identify and apply the properties of real numbers (closure, commutative, associative, distributive, identity, inverse)</p> <p>A.N.2 Simplify radical terms (no variable in the radicand)</p> <p>A.N.5 Solve algebraic problems arising from situations that involve fractions, decimals, percents (decrease/increase and discount), and proportionality / direct variation</p>	<p><i>Unit 3- Functions and Graphs Operations</i></p> <p>A.N.5 Solve algebraic problems arising from situations that involve fractions, decimals, percents (decrease/increase and discount), and proportionality/direct variation</p>

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	<b>September / October</b>	<b>October / November</b>	<b>December / January</b>
<b>Algebra Strand</b>	<p style="text-align: center;"><b><i>Variables and Expressions</i></b></p> <p>A.A.1 Translate a quantitative verbal phrase into an algebraic expression A.A.2 Write a verbal expression that matches a given mathematical expression</p> <p style="text-align: center;"><b><i>Equations and Inequalities</i></b></p> <p>A.A.3 Distinguish the difference between an algebraic expression and an algebraic equation A.A.4 Translate verbal sentences into mathematical equations or inequalities A.A.5 Write algebraic equations or inequalities that represent a situation</p> <p style="text-align: center;"><b><i>Variables and Expressions</i></b></p> <p>A.A.13 Add, subtract, and multiply monomials and polynomials</p>	<p style="text-align: center;"><b><i>Equations and Inequalities</i></b></p> <p>A.A.4 Translate verbal sentences into mathematical equations or inequalities A.A.5 Write algebraic equations or inequalities that represent a situation A.A.6 Analyze and solve verbal problems whose solution requires solving a linear equation in one variable or linear inequality in one variable A.A.21 Determine whether a given value is a solution to a given linear equation in one variable or linear inequality in one variable A.A.22 Solve all types of linear equations in one variable. A.A.24 Solve linear inequalities in one variable A.A.25 Solve equations involving fractional expressions A.A.26 Solve algebraic proportions in one variable which result in linear or quadratic equations</p> <p style="text-align: center;"><b><i>Patterns, Relations and Functions</i></b></p> <p>A.A.29 Use set-builder notation and/or interval notation to illustrate the elements of a set, given the elements in roster form A.A.30 Find the complement of a subset of a given set, within a given universe</p>	<p style="text-align: center;"><b><i>Equations and Inequalities</i></b></p> <p>A.A.5 Write algebraic equations or inequalities that represent a situation</p> <p style="text-align: center;"><b><i>Coordinate Geometry</i></b></p> <p>A.A.32 Explain slope as a rate of change between dependent and independent variables. A.A.33 Determine the slope of a line, given the coordinates of two points on the line A.A.34 Write the equation of a line, given its slope and the coordinates of a point on the line A.A.35 Write the equation of a line, given the coordinates of two points on the line A.A.36 Write the equation of a line parallel to the x- or y-axis A.A.37 Determine the slope of a line, given its equation in any form A.A.38 Determine if two lines are parallel, given their equations in any form</p>

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		A.A.31 Find the intersection of sets (no more than three sets) and/or union of sets (no more than three sets) A.A.45 Determine the measure of a third side of a right triangle using the Pythagorean theorem, given the lengths of any two sides	
<b>Geometry Strand</b>	<p style="text-align: center;"><i>Coordinate Geometry</i></p> A.G.3 Determine when a relation is a function, by examining ordered pairs and inspecting graphs of relations	<p style="text-align: center;"><i>Coordinate Geometry</i></p> A.G.4 Identify and graph linear, quadratic (parabolic), absolute value, and exponential functions A.G.5 Investigate and generalize how changing the coefficients of a function affects its graph A.G.6 Graph linear inequalities	<p style="text-align: center;"><i>Coordinate Geometry</i></p> A.G.3 Determine when a relation is a function, by examining ordered pairs and inspecting graphs of relations A.G.4 Identify and graph linear, quadratic (parabolic), absolute value, and exponential functions A.G.5 Investigate and generalize how changing the coefficients of a function affects its graph
<b>Measurement Strand</b>			<p style="text-align: center;"><i>Units of Measurement</i></p> A.M.1 Calculate rates using appropriate units (e.g., rate of a space ship versus the rate of a snail) A.M.2 Solve problems involving conversions within measurement systems, given the relationship between the units <p style="text-align: center;"><i>Error and Magnitude</i></p> A.M.3 Calculate the relative error in measuring square and cubic units, when there is an error in the linear measure

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Statistics and Probability Strand	<p style="text-align: center;"><b><i>Organization and Display of Data</i></b></p> <p>A.S.1 Categorize data as qualitative or quantitative  A.S.2 Determine whether the data to be analyzed is univariate or bivariate  A.S.3 Determine when collected data or display of data may be biased  A.S.4 Compare and contrast the appropriateness of different measures of central tendency for a given data set  A.S.5 Construct a histogram, cumulative frequency histogram, and a box-and-whisker plot, given a set of data  A.S.6 Understand how the five statistical summary (minimum, maximum, and the three quartiles) is used to construct a box-and-whisker plot  A.S.7 Create a scatter plot of bivariate data  A.S.8 Construct manually a reasonable line of best fit for a scatter plot and determine the equation of that line</p> <p style="text-align: center;"><b><i>Analysis of Data</i></b></p> <p>A.S.9 Analyze and interpret a frequency distribution table or histogram, a cumulative frequency distribution table or histogram, or a box-and-whisker plot  A.S.11 Find the percentile rank of an item in a data set and identify the point values for first, second, and third quartiles  A.S.12 Identify the relationship between the independent and dependent variables from a scatter plot (positive, negative, or none)  A.S.13 Understand the difference between correlation and causation  A.S.14 Identify variables that might have a correlation but not a causal relationship</p> <p style="text-align: center;"><b><i>Predictions from Data</i></b></p> <p>A.S.16 Recognize how linear transformations of one-variable data affect the data's mean, median, mode, and range  A.S.17 Use a reasonable line of best fit to make a prediction involving interpolation or extrapolation</p> <p style="text-align: center;"><b><i>Probability</i></b></p> <p>A.S.18 Know the definition of conditional probability and use it to solve for probabilities in finite sample spaces  A.S.19 Determine the number of elements in a sample space and the number of favorable events  A.S.20 Calculate the probability of an event and its complement  A.S.21 Determine empirical probabilities based on specific sample data  A.S.23 Calculate the probability of: a series of independent events; a series of dependent events; two mutually exclusive events; two events that are not mutually exclusive</p>	<p style="text-align: center;"><b><i>Organization and Display of Data</i></b></p> <p>A.S.7 Create a scatter plot of bivariate data  A.S.8 Construct manually a reasonable line of best fit for a scatter plot and determine the equation of that line</p> <p style="text-align: center;"><b><i>Predictions from Data</i></b></p> <p>A.S.17 Use a reasonable line of best fit to make a prediction involving interpolation or extrapolation</p>
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	<i>Unit 4- Systems of Equations and Inequalities</i>	<i>Unit 5- Exponents, Polynomials, Factoring</i>	<i>Unit 6 - Quadratic Functions, Radicals, Trigonometric Ratios</i>	<i>Unit 7- Rational Expressions, Combinations and Permutations</i>
<b>Number Sense and Operations Strand</b>		<p style="text-align: center;"><i>Operations</i></p> <p>A.N.4 Understand and use scientific notation to compute products and quotients of numbers A.N.6 Evaluate expressions involving factorials, absolute values and exponential expressions</p>	<p style="text-align: center;"><i>Operations</i></p> <p>A.N.2 Simplify radical terms (no variable in the radicand) A.N.3 Perform the four arithmetic operations using like and unlike radical terms and express the result in simplest form</p>	<p style="text-align: center;"><i>Operations</i></p> <p>A.N.7 Determine the number of possible events, using counting techniques or the Fundamental Principle of Counting A.N.8 Determine the number of possible arrangements (permutations) of a list of items</p>
<b>Algebra Strand</b>	<p style="text-align: center;"><i>Equations and Inequalities</i></p> <p>A.A.6 Analyze and solve verbal problems whose solution requires solving a linear equation in one variable or linear inequality in one variable A.A.7 Analyze and solve verbal problems whose solution requires solving systems of linear equations in two variables A.A.10 Solve systems of two linear equations in two variables algebraically (See A.G.7) A.A.21 Determine whether a given value is a solution to a given linear equation in one variable or linear inequality in one variable</p> <p style="text-align: center;"><i>Coordinate Geometry</i></p> <p>A.A.40 Determine whether a given point is in the solution set of a system of linear inequalities</p>	<p style="text-align: center;"><i>Equations and Inequalities</i></p> <p>A.A.9 Analyze and solve verbal problems that involve exponential growth and decay A.A.12 Multiply and divide monomial expressions with a common base, using the properties of exponents <i>Note: Use integral exponents only.</i> A.A.13 Add, subtract, and multiply monomials and polynomials A.A.19 Identify and factor the difference of two perfect squares A.A.20 Factor algebraic expressions completely, including trinomials with a lead coefficient of one (after factoring a GCF)</p>	<p style="text-align: center;"><i>Equations and Inequalities</i></p> <p>A.A.8 Analyze and solve verbal problems that involve quadratic equations A.A.11 Solve a system of one linear and one quadratic equation in two variables, where only factoring is required A.A.27 Understand and apply the multiplication property of zero to solve quadratic equations with integral coefficients and integral roots A.A.28 Understand the difference and connection between roots of a quadratic equation and factors of a quadratic expression</p>	<p style="text-align: center;"><i>Variables and Expressions</i></p> <p>A.A.14 Divide a polynomial by a monomial or binomial, where the quotient has no remainder A.A.15 Find values of a variable for which an algebraic fraction is undefined A.A.16 Simplify fractions with polynomials in the numerator and denominator by factoring both and renaming them to lowest terms A.A.17 Add or subtract fractional expressions with monomial or like binomial denominators A.A.18 Multiply and divide algebraic fractions and express the product or quotient in simplest form A.A.20 Factor algebraic expressions completely, including trinomials with a lead coefficient of one (after factoring a GCF)</p>

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<b>Algebra Strand</b>			<p><b><i>Trigonometric Functions</i></b>            A.A.42 Find the sine, cosine, and tangent ratios of an angle of a right triangle, given the lengths of the sides            A.A.43 Determine the measure of an angle of a right triangle, given the lengths of any two sides            A.A.44 Find the measure of a side of a right triangle, given an acute angle and the length of another side</p>	<p><b><i>Equations and Inequalities</i></b>            A.A.26 Solve algebraic proportions in one variable which result in linear or quadratic equations</p>
<b>Geometry Strand</b>	<p><b><i>Coordinate Geometry</i></b>            A.G.6 Graph linear inequalities            A.G.7 Graph and solve systems of linear equations and inequalities with rational coefficients in two variables</p>	<p><b><i>Coordinate Geometry</i></b>            A.G.4 Identify and graph linear, quadratic (parabolic), absolute value and exponential functions</p>	<p><b><i>Coordinate Geometry</i></b>            A.G.4 Identify and graph linear, quadratic (parabolic), absolute value and exponential functions            A.G.8 Find the roots of a parabolic function graphically            A.G.9 Solve systems of linear and quadratic equations graphically            A.G.10 Determine the vertex and axis of symmetry of a parabola, given its graph</p>	
<b>Statistics and Probability Strand</b>		<p><b><i>Organization and Display of Data</i></b>            A.S.1 Categorize data as qualitative or quantitative            A.S.2 Determine whether the data to be analyzed is univariate or bivariate            A.S.3 Determine when collected data or display of data may be biased</p>		

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