MASSACHUSETTS SAMPLE CURRICULUM MAP

Mathematics

Grade 8

June 2013

Introduction to the Sample Grade 8 Curriculum Map for Mathematics

The curriculum map on the following pages illustrates just **one** way to organize the grade 8 standards from the 2011 *Massachusetts Curriculum Framework for Mathematics,* which incorporates the *Common Core State Standards,* into a coherent yearlong learning sequence. The map is intentionally spare, made with the recognition that district staff will adapt it to suit their students and to include resources such as specific texts, assignments, assessments, or background materials for teachers.

The map includes two Grade 8 Model Curriculum Units, titled *Ratios and Rates* and *Analyzing* and *Solving Linear Equations and Pairs of Linear Simultaneous Equations* that integrates the grade 8 mathematics content standards and the standards for mathematical practices. The Grade 8 Model Curriculum Units included in this map were developed by the Massachusetts Department of Elementary and Secondary Education (ESE) with support from the United States Department of Education's Race to the Top grant. Titles of the Model Curriculum Units are included in the "Unit Column." This column also serves as a placeholder for the placement of additional units that may already exist or will be created locally. The culminating performance assessments that belong with the model units are listed in the "Assessment Column". The assessment column can be used to list additional local assessments including pre-assessments, performance tasks, district assessments, and teacher created unit assessments.

Primary resources used in creating this sample map were the *Massachusetts Curriculum Framework for Mathematics* (2011) and the *PARCC Model Content Frameworks for Mathematics* (November 2012). Additional materials that districts may want to use to inform alignment work are the WIDA standards for English language learners (2012) or the Massachusetts Department of Elementary and Secondary Education's *Resource Guide to Mathematics for Students with Disabilities* (in press, 2013).

The sample curriculum map is one of three developed as part of the Department's Race to the Top work. Based on the work of Heidi Hayes Jacobs and Associates, the collection includes sample maps for these grades and subject areas:
- Grade 2 English Language Arts and Literacy
- Grade 4 History and Social Science
- Grade 8 Mathematics

The general format of these curriculum maps may, of course, be used for other grades and subjects.

Overview of the Grade 8 Mathematics Standards

In grade 8, students extend their study of algebraic concepts which began in the earlier grades. Grade 8 students work with rational and irrational numbers, linear equations, functions, the Pythagorean Theorem, transformations, and bivariate data. Students compare functions to other functions. They learn to formulate and reason about expressions and equations, use functions to describe quantitative relationships, and apply the Pythagorean Theorem. A major emphasis is working with radicals, integers, and exponents.

In grade 8, instructional time should focus 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 (MA Curriculum Framework for Mathematics, 2011).

Students will apply an understanding of proportional relationships with linear equations. Students engage in the content as mathematicians using problem solving strategies and reasoning skills. Students also engage in the application of literacy standards such as writing arguments and citing evidence. Students use the Standards of Mathematical Practice as they interact with the content.

Some of the standards may be revisited several times throughout the year although they are not restated in the map. The eight mathematical practices (MP) are integrated into the content throughout the year, whenever appropriate, so that students become accustomed to noticing and applying them to all their mathematical reasoning. Notes on the Standards for Mathematical Practice are included to identify examples throughout this map, though the instances are not exhaustive.

Academic Language in the Standards Addressed throughout the Year
The following words and phrases appear in the standards. Using this academic language with students strengthens their ability to master the content and to apply it in various settings.

rational numbers, irrational numbers, number line diagram, radicals, integer exponents, square root, equations, proportional relationships, linear equations, simultaneous linear equations, variables, equations, intersects, function, functional relationships, linear function, rate of change, algebraic expression, value of expression, quantitative, qualitative, table of values, Pythagorean Theorem, right triangle, volume, cylinder, , informal arguments, similar triangles, congruence, congruent figures, similarity, converse, table of values, linear, not linear, rotations, reflections, translations, dilations, informal argument, truncating, angle sum, exterior angle of triangles, parallel lines, transversal, angle-angle criterion for similarity of triangles, similar triangles, exterior angle-angle su*m,* coordinate system, cones, cylinders, spheres, formula, decimal expansion, number line diagram, scientific notation, slope, unit rate, , non-vertical line, coordinate plane, vertical axis, district points, derive the equation, transforming, infinitely, coefficients, rational number, decimal notation, representing algebraically, numerically, graphically; linear association, nonlinear association, linear model, frequencies, relative frequencies, patterns of association, linear association, non-linear association, non-vertical line, model fit, physical model, scatter plots, clustering, outliers, intercept, frequencies, variables, origin, y-intercept.

Yearlong Grade 8 Mathematics Curriculum Map at a Glance

MATHEMATICS – GRADE 8		
MONTHS	**CONTENT**	**STANDARDS**
August/September (3 weeks)	Radicals and Irrational Numbers	8.NS.1, 2 8.EE.2 8.G.9 MP 1, 2, 6, 7, 8
September - October (3 weeks)	Exponents and Scientific Notation	8.EE.1, 3, 4 MP 6, 7, 8
October-November (4 weeks)	Congruence and Similarity	8.G.1, 2, 3, 4, 5, MP 2, 4, 5, 6, 7
November-December (4 weeks)	Functional Relationships	8.F.1, 2, 5 MP 2, 4, 6, 8
January-February (4 weeks)	Linear Relationships	8.EE 5,6 8.F.3, 4 8.SP.3 MP 1, 2, 4, 6, 7, 8
February-April (8 weeks)	Linear Equations & Simultaneous Equations	8.EE.7, 8 MP 4, 6, 7, 8
April/May (3 weeks)	Pythagorean Theorem	8.G.6 8.G.7 8.G.8 MP 1, 2, 3, 4
May/June (3 weeks)	Statistics	8.SP. 1, 2, 4 MP 1, 2, 3, 4, 6, 8

TIME	MATHEMATICS STANDARDS	STANDARDS FOR MATHEMATICAL PRACTICE	CURRICULUM UNIT	ASSESSMENTS
August/ September (3 weeks)	**Rational and Irrational Numbers** 8.NS.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. 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. 8.EE.2 Use square root and cube root symbols to represent solutions to equations of the form $x2 = p$ and $x3 = p$, 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. 8.G.9 Know the formulas for the volumes of cones, cylinders, and spheres, and use them to solve real-world and mathematical problems.	MP1 Make sense of problems and preserve in solving them. MP2 Reason abstractly and quantitatively. MP6 Attend to precision. MP7 Look for and make use of structure. MP8 Look for and express regularity in repeated reasoning.		Pre-test Formative Assessments Summative Assessment
TIME	MATHEMATICS STANDARDS	STANDARDS FOR MATHEMATICAL PRACTICE	CURRICULUM UNIT	ASSESSMENTS

| September - October (3 weeks) | **Exponents and Scientific Notation**

8.EE.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.

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.

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. | MP6 Attend to precision

MP7 Look for and make use of structure.

MP8 Look for and express regularity in repeated reasoning. | | |

TIME	MATHEMATICS STANDARDS	STANDARDS FOR MATHEMATICAL PRACTICE	CURRICULUM UNIT	ASSESSMENTS
October-November (4 weeks)	**Congruence and Similarity** 8.G.1 Verify experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines. 8.G.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. 8.G.3 Describe the effects of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. 8.G.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. 8.G.5 Use informal arguments to establish	MP4 Model with mathematics MP5 Use appropriate tools strategically MP6 Attend to precision		

	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.			
November-December (4 weeks)	**Functional Relationships** 8.F.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. 8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). 8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph. Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	MP2 Reason abstractly and quantitatively. MP4 Model with mathematics. MP6 Attend to precision. MP8 Look for and express regularity in repeated reasoning.		

TIME	MATHEMATICS STANDARDS	STANDARDS FOR MATHEMATICAL PRACTICE	CURRICULUM UNIT	ASSESSMENTS
January-February (4 weeks)	**Linear Relationships** 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. 8.F.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 = s2 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. 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	MP1 Make sense of problems and persevere in solving them. MP2 Reason abstractly and quantitatively MP4 Model with mathematics. MP6 Attend to precision. MP7 Look for and make use of structure. MP8 Look for and express regularity in repeated reasoning.	Model Curriculum Unit: *Connecting Proportions, Lines and Linear Equations*	Model Curriculum Unit includes: Curriculum Embedded Performance Assessment- *Summer Work- Comparing Jobs* Formative Assessment Summative Assessment

	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.SP.3 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.			

TIME	MATHEMATICS STANDARDS	STANDARDS FOR MATHEMATICAL PRACTICE	CURRICULUM UNIT	ASSESSMENTS
February-April (8 weeks)	**Linear Equations and Simultaneous Equations** 8.EE.7 Solve linear equations in one variable. 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 $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. 8.EE.8 Analyze and solve pairs of simultaneous linear equations. 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. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. 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.	MP1 Make sense of problems and persevere in solving them. MP2 Reason abstractly and quantitatively. MP3 Construct viable arguments and critique the reasoning of others MP4 Model with mathematics. MP6 Attend to precision. MP7 Look for and make use of structure. MP8 Look for and express regularity in repeated reasoning.	Model Curriculum Unit: *Analyzing and Solving Linear Equations and Pairs of Linear Simultaneous Equations*	Model Curriculum Unit: Curriculum Embedded Performance Assessment- *Powering Up Patriot School* Formative Assessment Summative Assessment

TIME	MATHEMATICS STANDARDS	STANDARDS FOR MATHEMATICAL PRACTICE	CURRICULUM UNIT	ASSESSMENTS
April/May (3 weeks)	**Pythagorean Theorem** 8.G.6 Explain a proof of the Pythagorean Theorem and its converse. 8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. 8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	MP1 Make sense of problems and persevere in solving them. MP2 Reason abstractly and quantitatively. MP3 Construct viable arguments and critique the reasoning of others. MP4 Model with mathematics.		
May/June (3 weeks)	**Statistics** 8.SP.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. 8.SP 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 by judging the closeness of the data points to the line.	MP1 Make sense of problems and persevere in solving them. MP2 Reason abstractly and quantitatively MP4 Model with mathematics. MP6 Attend to precision. MP8 Look for and		

	8.SP.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.	express regularity in repeated reasoning. .		

Reference:

MASSACHUSETTS CURRICULUM FRAMEWORK FOR MATHEMATICS Grades Pre-Kindergarten to 12 Incorporating the Common Core State Standards for Mathematics, March 2011