San Mateo Union High School District
Course of Study

Algebra I

Approved by
BOARD OF TRUSTEES
May 12, 2016

I. Course Description

A. UC/CSU "a-g" Subject Area: C) Mathematics
B. Rationale for Course: The California state standards in mathematics have changed. We need new courses of study that reflect the changes in content, practice, and rigor. The overall goal will be to increase A-G completion rates. Algebra I is the first course that meet college and career readiness standards in mathematics.
C. Grade Level: 9 - 10
D. Credits: 10 Math
E. Pre-Requisites: None
F. Brief Course Description: The main purpose of Algebra I is to develop students' fluency with linear, quadratic, and exponential functions. The critical areas of instruction involve deepening and extending students' understanding of linear and exponential relationships by comparing and contrasting those relationships and by applying linear models to data that exhibit a linear trend. In addition, students engage in methods for analyzing, solving, and using exponential and quadratic functions. Some of the overarching elements of the Algebra I course include the notion of *function,* solving equations, rates of change and growth patterns, graphs as representations of functions, and modeling.

II. Course Purpose: Goals and Student Outcomes

Students demonstrate the mathematical practice standards by:

- Students learn that patience is often required to fully understand what a problem is asking. They discern between useful and extraneous information. They expand their repertoire of expressions and functions that can be used to solve problems.
- Students extend their understanding of slope as the rate of change of a linear function to comprehend that the average rate of change of any function can be computed over an appropriate interval.
- Students reason through the solving of equations, recognizing that solving an equation involves more than simply following rote rules and steps. They use language such as "If, then " when explaining their solution methods and provide justification for their reasoning.
- Students also discover mathematics through experimentation and by examining data patterns from real-world contexts. Students apply their

new mathematical understanding of exponential, linear, and quadratic functions to real-world problems.

- Students develop a general understanding of the graph of an equation or function as a representation of that object, and they use tools such as graphing calculators or graphing software to create graphs in more complex examples, understanding how to interpret results. They construct diagrams to solve problems.
- Students begin to understand that a rational number has a specific definition and that irrational numbers exist. They make use of the definition of function when deciding if an equation can describe a function by asking, “Does every input value have exactly one output value?”
- Students develop formulas such as $(a \pm b)^2 = a^2 \pm 2ab + b^2$ by applying the distributive property. Students see that the expression $5 + (x-2)^2$ takes the form of 5 plus “something squared,” and because “something squared” must be positive or zero, the expression can be no smaller than 5.
- Students see that the key feature of a line in the plane is an equal difference in outputs over equal intervals of inputs, and that the result of evaluating the expression $\frac{y_2 - y_1}{x_2 - x_1}$ for points on the line is always equal to a certain number m. Therefore, if (x, y) is a generic point on this line, the equation $m = \frac{y - y_1}{x - x_1}$ will give a general equation of that line.

Students demonstrate the content standards:

- Students will understand the concept of a function and use function notation.
- Students will interpret functions that arise in applications in terms of the context.
- Students will analyze functions using different representations.
- Students will build a function that models a relationship between two quantities.
- Students will build new functions from existing functions.
- Students will construct and compare linear, quadratic, and exponential models and solve problems.
- Students will interpret expressions for functions in terms of the situation they model.
- Students will extend the properties of exponents to rational exponents.
- Students will use properties of rational and irrational numbers.
- Students will reason quantitatively and use units to solve problems.
- Students will interpret the structure of expressions.
- Students will write expressions in equivalent forms to solve problems.
- Students will perform arithmetic operations on polynomials.
- Students will create equations that describe numbers or relationships.

- Students will understand solving equations as a process of reasoning and explain the reasoning.
- Students will solve equations and inequalities in one variable.
- Students will solve systems of equations.
- Students will represent and solve equations and inequalities graphically.
- Students will summarize, represent, and interpret data on a single count or measurement variable.
- Students will summarize, represent, and interpret data on two categorical and quantitative variables.
- Students will interpret linear models.

III. Course Outline

I. Equations and Inequalities: Students analyze and explain precisely the process of solving an equation. Students, through reasoning, develop fluency writing, interpreting, and translating between various forms of linear equations and inequalities.

II. Linear Functions and Systems: This unit builds upon students' prior knowledge of linear models. Students learn function notation and develop the concepts of domain and range. Recognizing a linear function as having a constant rate of change, students will interpret the slope in the context of a situation. Arithmetic sequences will be referenced as a special type of linear function. Students expand their experience with functions to include more specialized functions – absolute value, step, and those that are piecewise-defined. Scatter plots and trend lines are also explored. Students then use linear functions to explore systems of equations and inequalities

III. Exponential Functions: Students build on their understanding of integer exponents to consider exponential functions with integer domains. They compare and contrast linear and exponential functions, looking for structure in each and distinguishing between additive and multiplicative change. They expand their understanding of arithmetic sequences as linear functions to interpret geometric sequences as exponential functions.

IV. Polynomials and Quadratic Functions: Students learn that polynomials form a system analogous to the integers upon which the students will learn to perform basic operations. Students will consider quadratic functions, comparing the key characteristics of quadratic functions to those of linear and exponential functions. Students learn through repeated reasoning to anticipate the graph of a quadratic function by interpreting the structure of various forms of quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function.

V. Data Analysis: Previously in this course, students worked with quantitative data. They will continue to do so as they learn to calculate measures of central tendency and spread. Students will branch into categorical data

where most will be displayed as relative frequencies in two-way frequency tables.

IV. Key Assignments

I. Building and Solving Complex Equations: This assignment assesses how well students are able to create and solve linear and non-linear equations. Students work individually on an assessment task that is designed to reveal current levels of understanding and difficulties. Then they work collaboratively building and solving equations in which the unknown appears more than once in the equation. http://map.mathshell.org/lessons.php?unit=9215&collection=8.

II. Representing Inequalities Graphically: This lesson assesses how well students are able to use linear inequalities to create a set of solutions. Students work individually on an assessment task that is designed to reveal current levels of understanding and difficulties. Then they work collaboratively, in pairs, on a game. One student decides on the position of a "target point" on a coordinate grid and gives clues in the form of algebraic inequalities (e.g., $3y + 2x < 12$). The other student uses these clues to find the location on the target point. In a whole-class discussion, students review the main math concepts of the math lesson. http://map.mathshell.org/lessons.php?unit=9265&collection=8

III. Modeling Population Growth: Having Kittens: This lesson assesses how well students are able to interpret a situation and represent the constraints and variables mathematically, select appropriate mathematical methods to use, make sensible estimates and assumptions, investigate an exponentially increasing sequence, and communicate their reasoning clearly. Students work individually on an assessment task that is designed to reveal current levels of understanding and difficulties. At the start of the lesson, students work individually answering questions about the same problem. In small groups, students then work collaboratively on the task. In the same small groups, students evaluate sample solutions. In a whole-class discussion, students explain and compare the alternative solution strategies they have seen and used *http://map.mathshell.org/lessons.php?unit=9100&collection=8*

IV. Representing Quadratic Functions Graphically: This lesson assesses how well students are able to understand what the different algebraic forms of a quadratic function reveal about the properties of its graphical representation.. Students work individually on an assessment task that is designed to reveal current levels of understanding and difficulties. Then they work collaboratively in small groups to match diagrammatic and algebraic representations of polynomials. They display their work on posters. Students share their finished posters, comparing reasoning, and checking that explanations are clear and complete. Students review their own solutions and complete a second

task to measure their learning. In particular, the lesson will identify and help students who have difficulty understanding how the factored form of the function can identify a graph's roots, understanding how the completed square form of the function can identify a graph's maximum or minimum point, and understanding how the standard form of the function can identify a graph's intercept.
http://map.mathshell.org/lessons.php?unit=9245&collection=8

V. Representing Data with Box Plots: This lesson assesses how well students are able to interpret data using frequency and box plots. A whole-class introduction provides students with guidance on how to work through the task. Students work in pairs or threes on a collaborative discussion task, matching frequency graphs to box plots. Towards the end of the lesson there is a whole-class discussion. In a follow-up lesson, students work alone on a similar task to the assessment task. In particular this lesson aims to identify and help students who have difficulty figuring out the data points and spread of data from frequency graphs and box plots.
http://map.mathshell.org/lessons.php?unit=9420&collection=8

V. Instructional Methods and/or Strategies

- Think - Pair - Share: Teacher asks a question or assigns a problem and allow students to think or work with a partner for one to five minutes before requesting an answer.
- Show thinking: Either verbally or written students need to explain how they arrived at a solution to a problem.
- Questioning and Wait Time: Teachers provide a thought provoking question to students, then allow the students time to think and work toward an answer.
- Group Work: Students are given challenging problems to work, and allowed to work on the problem in a group of two, three, or four. Challenging mathematics problems take time, effort, reasoning, and thinking to solve. Group work is an important teaching strategy for having students work on the common core performance tasks.
- Allowing Students to Struggle: Students learn to persevere in solving challenging mathematics problems by being allowed to struggle with challenging problems. Students need to understand that mathematical problems do not usually have a quick, easy solution. Effective effort is a life-skill and should be learned interdependently and independently.

VI. Assessment Methods and/or Tools

Formative assessments will be used with constructed response questions. Each chapter will have a summative exam that includes no more than 50% new material, projects will be included in the grade and there will be two final exams, one at the end of the first and second semester.

VII. Textbook(s) and Supplemental Instructional Materials

CPM Core Connections; http://map.mathshell.org; MARS/MAC tasks; NCTM Illuminations, Math Vision Project, Ed Puzzle, IXL, That Quiz, Graphing calculators TI-84 Silver Edition, Math Type Software, Smart View Software, graph paper, rulers, individual student whiteboards, LCD projector, document reader, Algebra tiles, and any other CCSS aligned materials