

## MATHEMATICS COURSE SYLLABUS

**Course Title:** *Transition from Algebra to Geometry I*

**Department:** Mathematics

**Primary Course Materials:** Big Ideas Math Algebra I Book Authors: Ron Larson & Laurie Boswell  
Algebra I Student Workbooks  
TI-Nspire CX CAS

**Course Description:** This course is designed for tenth grade students who continue to demonstrate the necessary ability, maturity, and motivation to be successful in a basic paced algebra program. All students will be actively engaged in Problem Solving, Reasoning, Connecting, and Communicating as they study the following topics: Solving Linear Equations, Graphing Linear Functions, Exponential Functions and Sequences, Polynomial Equations and Factoring, Graphing Quadratic Functions, Solving Quadratic Equations, and Data Analysis and Displays.

Students will be required to keep a notebook, read and interpret the algebra text and complete independent and group work. Emphasis will be placed on investigating and solving real world problems that will include open-ended and open response questions to assist in preparing students for the MCAS exam.

### **Essential Questions:**

1. Where and how are algebraic operations and concepts used to solve everyday problems?
2. How does algebra help us understand and relate to other objects as well as to other areas of mathematics?
3. How are the function families used to analyze real world applications in a variety of disciplines such as science, business, and economics?
4. How are function families used to model real world systems such as moving objects, revenue costs, population, and cost & profit?
5. How are transformational properties of function families related to the algebraic representations of a function?
6. How can technology be used to deepen understanding of function families and algebraic structures?

**Course Objectives:** This course addresses the following common goals for Chelmsford High School:

### **Common Goals:** 21<sup>st</sup> Century Learning Expectations

#### **Thinking and Communicating**

- 1)  Read information critically to develop understanding of concepts, topics and issues.
- 2)  Write clearly, factually, persuasively and creatively in Standard English.
- 3)  Speak clearly, factually, persuasively and creatively in Standard English.
- 4)  Use computers and other technologies to obtain, organize and communicate information and to solve problems.
- 5)  Conduct research to interpret issues or solve complex problems using a variety of data and information sources.
- 6)  Demonstrate transliteracy by communicating across a range of platforms, tools and media.
- 7)  Utilize real-world digital tools and other resources to access, evaluate and share information in an authentic task.
- 8)  Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits and working/learning conditions.

#### **Gain and Apply Knowledge in and across the Disciplines**

- 9) Gain and Apply Knowledge in:
  - a)  Literature and Language

- b)  Mathematics
- c)  Science and Technology
- d)  Social Studies, History and Geography
- e)  Visual and Performing Arts
- f)  Health and Physical Education

### Work and Contribute

- 10)  Demonstrate personal responsibility for planning one's future academic and career options.
- 11)  Participate in a school or community service activity.
- 12)  Develop informed opinions about current economic, environmental, political and social issues affecting Massachusetts, the United States and the world and understand how citizens can participate in the political and legal system to affect improvements in these areas.
- 13)  Work independently and collaboratively to solve problems and accomplish goals.
- 14)  Value and demonstrate personal responsibility, ethical behavior and global awareness in both academic and social communities.

### Learning Standards from the Massachusetts Curriculum Framework:

A chart is attached identifying which of the standards from the Massachusetts Curriculum Frameworks will be assessed in this course.

## PACING GUIDE

### Chapter 1: Solving Linear Equations (review)

(9 DAYS)

- 1.1 Solving Simple Equations
- 1.2 Solving Multi- Step Equations
- 1.3 Solving Equations with Variables on Both Sides
- 1.4 Solving Absolute Value Equations

### Chapter 3: Graphing Linear Functions (review)

(11 DAYS)

- 3.1 Functions
- 3.2 Linear Functions
- 3.3 Function Notation
- 3.4 Graphing Linear Equations in Standard Form
- 3.5 Graphing Linear Equations in Slope- Intercept Form

### Chapter 6: Exponential Functions and Sequences (21 DAYS)

- 6.1 Properties of Exponents
- 6.2 Radicals and Rational Exponents
- 6.3 Exponential Functions
- 6.4 Exponential Growth and Decay
- 6.5 Solving Exponential Equations
- 6.6 Geometric Sequences

### Chapter 7: Polynomial Equations and Factoring (23 DAYS)

- 7.1 Adding and Subtracting Polynomials
- 7.2 Multiplying Polynomials
- 7.3 Special Products of Polynomials
- 7.4 Solving Polynomial Equations in Factored Form
- 7.5 Factoring  $x^2 + bx + c$
- 7.6 Factoring  $ax^2 + bx + c$
- 7.7 Factoring Special Products
- 7.8 Factoring Polynomials Completely

### Chapter 8: Graphing Quadratic Functions (21 DAYS)

- 8.1 Graphing  $f(x) = ax^2$
- 8.2 Graphing  $f(x) = ax^2 + c$
- 8.3 Graphing  $f(x) = ax^2 + bx + c$
- 8.4 Graphing  $f(x) = a(x - h)^2 + k$
- 8.5 Using Intercept Form
- 8.6 Comparing Linear, Exponential, and Quadratic Functions

**Chapter 9: Solving Quadratic Equations (27 DAYS)**

- 9.1 Properties of radicals
- 9.2 Solving Quadratic Equations by graphing
- 9.3 Solving Quadratic Equations using Square roots
- 9.4 Solving Quadratic Equations by completing the square
- 9.5 Solving Quadratic Equations using the quadratic formula

**Chapter 11: Data Analysis and Displays (8 DAYS)**

- 11.1 Measures of center and variation – (eliminate standard deviation)
- 11.2 Box-and-Whisker plots
- 11.5 Choosing data display- (light coverage)

## High School Content Standards

<b>Conceptual Category: Number and Quantity</b>	
N-RN	<p>The Real Number System</p> <hr/> <p>Extend the properties of exponents to rational exponents.</p> <ol style="list-style-type: none"> <li>1. Explain how the definition of the meaning of rational exponent follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. <i>For example, we define <math>5^{1/3}</math> to be the cube root of 5 because we want <math>(5^{1/3})^3 = 5^{(1/3)3}</math> to hold, so <math>(5^{1/3})^3</math> must equal 5.</i></li> <li>2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.</li> </ol> <p>Use properties of rational and irrational numbers.</p> <ol style="list-style-type: none"> <li>3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.</li> </ol>
N-Q	<p>Quantities</p> <hr/> <p>Reason quantitatively and use units to solve problems.</p> <ol style="list-style-type: none"> <li>1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. *</li> <li>2. Define appropriate quantities for the purpose of descriptive modeling. ★</li> </ol>

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	<p>3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ★</p> <p>MA.3.a. Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements. Identify significant figures in recorded measures and computed values based on the context given and the precision of the tools used to measure. ★</p>
	<p><b>Conceptual Category: Algebra</b></p>
A-SSE	<p>Seeing Structure in Expressions</p> <hr/> <p>Interpret the structure of expressions.</p> <p>1. Interpret expressions that represent a quantity in terms of its context. ★</p> <p>a. Interpret parts of an expression, such as terms, factors, and coefficients.</p> <p>b. Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret <math>P(1 + r)^n</math> as the product of <math>P</math> and a factor not depending on <math>P</math>.</i></p> <p>2. Use the structure of an expression to identify ways to rewrite it. <i>For example, see <math>x^4 - y^4</math> as <math>(x^2)^2 - (y^2)^2</math>, thus recognizing it as a difference of squares that can be factored as <math>(x^2 - y^2)(x^2 + y^2)</math>.</i></p> <p>Write expressions in equivalent forms to solve problems.</p> <p>3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p>a. Factor a quadratic expression to reveal the zeros of the function it defines.</p> <p>b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</p> <p>c. Use the properties of exponents to transform expressions for exponential functions. <i>For example, the expression <math>1.15^t</math> can be rewritten as <math>(1.15^{1/12})^{12t} \approx 1.012^{12t}</math> to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</i></p> <p>4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. <i>For example, calculate mortgage payments.</i></p>
A-CED	<p>Creating Equations</p> <hr/> <p>Create equations that describe numbers or relationships.</p> <p>1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. ★</p> <p>2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. ★</p> <p>3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret</p>

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	solutions as viable or non-viable options in a modeling context. <i>For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*</i>
A-REI	<p>Reasoning with Equations and Inequalities</p> <p>Understand solving equations as a process of reasoning and explain the reasoning.</p> <ol style="list-style-type: none"> <li>1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.</li> <li>2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.</li> </ol> <p>Solve equations and inequalities in one variable.</p> <ol style="list-style-type: none"> <li>3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. MA.3.a. Solve linear equations and inequalities in one variable involving absolute value.</li> <li>4. Solve quadratic equations in one variable. <ol style="list-style-type: none"> <li>a. Use the method of completing the square to transform any quadratic equation in <math>x</math> into an equation of the form <math>(x - p)^2 = q</math> that has the same solutions. Derive the quadratic formula from this form.</li> <li>b. Solve quadratic equations by inspection (e.g., for <math>x^2 = 49</math>), taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as <math>a \pm bi</math> for real numbers <math>a</math> and <math>b</math>. MA.4.c. Demonstrate an understanding of the equivalence of factoring, completing the square, or using the quadratic formula to solve quadratic equations.</li> </ol> </li> </ol>
<b>Conceptual Category: Functions</b>	
F-IF	<p>Understand the concept of a function and use function notation.</p> <ol style="list-style-type: none"> <li>1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If <math>f</math> is a function and <math>x</math> is an element of its domain, then <math>f(x)</math> denotes the output of <math>f</math> corresponding to the input <math>x</math>. The graph of <math>f</math> is the graph of the equation <math>y = f(x)</math>.</li> <li>2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.</li> <li>3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. <i>For example, the Fibonacci sequence is defined recursively by <math>f(0) = f(1) = 1, f(n + 1) = f(n) + f(n - 1)</math> for <math>n \geq 1</math>.</i></li> </ol> <p>Interpret functions that arise in applications in terms of the context.</p> <ol style="list-style-type: none"> <li>4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. <i>Key features include: intercepts; intervals where the function is</i></li> </ol>

	<p><i>increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> *</p> <p>5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>For example, if the function <math>h(n)</math> gives the number of person-hours it takes to assemble <math>n</math> engines in a factory, then the positive integers would be an appropriate domain for the function.</i> *</p> <p>6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. *</p> <p>Analyze functions using different representations.</p> <p>7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. *</p> <p>a. Graph linear and quadratic functions and show intercepts, maxima, and minima. *</p> <p>b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. *</p> <p>c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. *</p> <p>d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. *</p> <p>e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. *</p> <p>8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.</p> <p>a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.</p> <p>b. Use the properties of exponents to interpret expressions for exponential functions. <i>For example, identify percent rate of change in functions such as <math>y = (1.02)^t</math>, <math>y = (0.97)^t</math>, <math>y = (1.01)^{12t}</math>, and <math>y = (1.2)^{t/10}</math>, and classify them as representing exponential growth or decay.</i></p> <p>MA.8.c. Translate among different representations of functions and relations: graphs, equations, point sets, and tables.</p> <p>9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</i></p> <p>10. Given algebraic, numeric and/or graphical representations of functions, recognize the function as polynomial, rational, logarithmic, exponential, or trigonometric.</p>
F-BF	Building Functions

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	<p>Build a function that models a relationship between two quantities.</p> <ol style="list-style-type: none"> <li>1. Write a function that describes a relationship between two quantities.*       <ol style="list-style-type: none"> <li>a. Determine an explicit expression, a recursive process, or steps for calculation from a context.*</li> <li>b. Combine standard function types using arithmetic operations. <i>For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.</i> *</li> <li>c. (+) Compose functions. <i>For example, if <math>T(y)</math> is the temperature in the atmosphere as a function of height, and <math>h(t)</math> is the height of a weather balloon as a function of time, then <math>T(h(t))</math> is the temperature at the location of the weather balloon as a function of time.</i> *</li> </ol> </li> <li>2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. *</li> </ol> <p>Build new functions from existing functions.</p> <ol style="list-style-type: none"> <li>3. Identify the effect on the graph of replacing <math>f(x)</math> by <math>f(x) + k</math>, <math>kf(x)</math>, <math>f(kx)</math>, and <math>f(x + k)</math> for specific values of <math>k</math> (both positive and negative); find the value of <math>k</math> given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. <i>Include recognizing even and odd functions from their graphs and algebraic expressions for them.</i></li> <li>4. Find inverse functions.       <ol style="list-style-type: none"> <li>a. Solve an equation of the form <math>f(x) = c</math> for a simple function <math>f</math> that has an inverse and write an expression for the inverse. <i>For example, <math>f(x) = 2x^3</math> or <math>f(x) = (x + 1)/(x - 1)</math> for <math>x \neq 1</math>.</i></li> </ol> </li> </ol>
F-LE	<p>Linear, Quadratic, and Exponential Models</p> <hr/> <p>Construct and compare linear, quadratic, and exponential models and solve problems.</p> <ol style="list-style-type: none"> <li>1. Distinguish between situations that can be modeled with linear functions and with exponential functions.*       <ol style="list-style-type: none"> <li>a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. *</li> <li>b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. *</li> <li>c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. *</li> </ol> </li> <li>2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).*</li> <li>3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*</li> <li>4. For exponential models, express as a logarithm the solution to <math>ab^{ct} = d</math> where <math>a</math>, <math>c</math>, and <math>d</math> are numbers and the base <math>b</math> is 2,</li> </ol>

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	<p>10, or <math>e</math>; evaluate the logarithm using technology. *</p> <p>Interpret expressions for functions in terms of the situation they model.</p> <p>5. Interpret the parameters in a linear or exponential function in terms of a context. *</p>
A-REI	<p>Reasoning with Equations and Inequalities</p> <hr/> <p>Solve systems of equations.</p> <p>1. (+) Represent a system of linear equations as a single matrix equation in a vector variable.</p> <p>2. (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension <math>3 \times 3</math> or greater).</p>
F-IF	<p>Interpreting Functions</p> <hr/> <p>Analyze functions using different representations.</p> <p>1. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. *</p> <p>d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. ★</p>
F-BF	<p>Building Functions</p> <hr/> <p>Build a function that models a relationship between two quantities.</p> <p>1. Write a function that describes a relationship between two quantities. *</p> <p>c. (+) Compose functions. <i>For example, if <math>T(y)</math> is the temperature in the atmosphere as a function of height, and <math>h(t)</math> is the height of a weather balloon as a function of time, then <math>T(h(t))</math> is the temperature at the location of the weather balloon as a function of time. ★</i></p> <p>Build new functions from existing functions.</p> <p>2. Find inverse functions.</p> <p>b. (+) Verify by composition that one function is the inverse of another.</p> <p>c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.</p> <p>d. (+) Produce an invertible function from a non-invertible function by restricting the domain.</p> <p>3. (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.</p>

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