Cologne Academy

Mathematics Department

Grade 8 Math (Algebra 1A)

(Aligned Text: Holt McDougal Algebra 1**)**

Core Knowledge Curriculum – 61% Aligned

Adopted: 08/2014

Board Approved: 08/28/2014

Updated: 08/12/2017 AU

Table of Contents

Highlighted items indicate overlap of MN State Standards and the Core Knowledge Sequence.

Boxed items indicate content to be introduced post-MCAs.

Math Department Lesson Essentials

Topic: Title of lesson.

***Objective:** Academic goal for students to achieve by end of lesson.

***Standard:** MN State Standard or Core Knowledge Sequence reference.

Agenda: Sequence of instruction and activities

Closure: Brief summary/overview of lesson. May include formative assessment.

Homework: Continued practice of lesson. May be used as formative assessment.

*Indicates required components.

Note: The text has been as closely aligned with MN State Standards but additional resources may be required to include all skills (including within the Core Knowledge Sequence). Resources may be located on the s:drive under Mathematics Resources and by grade level or on the Cologne Academy intranet. Further research/exploration may be required to locate additional resources.

Important Dates 2017 – 2018

Pretest: 28 – 29 August
Interim 1: 30 – 31 October
Interim 2: 11 – 12 January
Interim 3: 19 – 20 March
Interim 4: 14 – 15 May
OLPA: 29 January – 2 February
MCA: 17 – 19 April
Dates may be subject to change.

Overview

Strand(s): Number & Operation

Unit 1: The Real Number System, Exponents and Scientific Notation, Expressions & Equations

Approximate Duration of Study: 8 Weeks Between Interims.

MNSS	Knowledge	Skills

Real Numbers
 	
8.1.1.1
8.1.1.2
8.1.1.3
	Students will know that:
	• A **rational number** can be expressed as a fraction where the denominator is not equal to 0.
	  ○ Rational numbers may belong to more than one subset.
	• A number that is not rational is **irrational**.
	• The square root of irrational numbers is irrational.
	• The square root of a positive **integer** can be an integer or irrational.
	• The product of a non-zero rational and irrational number is irrational.
		Student will be able to:
		• Classify real numbers as rational or irrational.
		  ○ Classify numbers as **integer**, **whole**, **natural**, **imaginary**.
		• Perform operations with rational and irrational numbers.

	• Irrational numbers are located between two consecutive integers on a number line.	• Compare and order real numbers. • Locate real numbers on a number line
	• Various methods can be used to approximate and verify solutions to problems involving real numbers.	• Estimate the square root of irrational numbers to the nearest tenth.

Simplify & Evaluate
 	
8.2.3.2
8.2.3.1
	Students will know that:
	• An **expression** is a number, a variable, or combination of both that does not include an equal sign or inequality symbol.
	• **Properties of Algebra** are used to generate equivalent expressions and justify the steps used to do so.
	• Properties of Algebra can be extended to variables.
	  ○ ***Associative Property***:
	  ▪ $(a + b) + c = a + (b + c)$; $(ab)c = a(bc)$
	  ○ ***Commutative Property***
	  ▪ $a + b = b + a$; $ab = ba$
	  ○ ***Distributive Property***
	  ▪ $a(b + c) = ab + ac$; $a(b - c) = ab - ac$
	  ○ ***Order of Operations (PEMDAS)***
	  ▪ *Parenthesis, Exponent, Multiplication/Division, Addition/Subtraction.*
		Student will be able to:
		• Justify procedures used to simplify algebraic expressions.
		• Show that commutative and associative properties will not work over subtraction and division.

	• A **variable** can be used to represent a number or quantity. Any expression, equation or inequality using variables must follow the Properties of Algebra.	• **Evaluate Algebraic Expression**s at specified values of their variables. • Evaluate expressions containing **radicals** and **absolute values**. ○ *Evaluate $\pi r^2 h$ when $r = 3$ and $h = 0.5$, and then use an approximation of π to obtain an approximate answer.*

Exponents
 	
8.1.1.4
	Students will know that:
	• Properties of negative, zero, and positive **exponents** generate **equivalent** numerical expressions.
	• Properties of Exponents:
	  ○ Any constant is raised to a power of 1: $7 = 7^1$
	  ○ $x^{-m} = \frac{1}{x^m} \rightarrow x^{-3} = \frac{1}{x^3}$
	  ○ $x^0 = 1 \rightarrow 26^0 = 1$
	  ○ $x^m \cdot x^n = x^{m+n} \rightarrow x^3 \cdot x^4 = x^7$
	  ○ $\frac{x^m}{x^n} = x^{m-n} \rightarrow \frac{x^7}{x^2} = x^5$
	  ○ $(x^m)^n = x^{m \cdot n} \rightarrow (7x^3)^2 = 49x^6$
		Student will be able to:
		• Create equivalent expressions by using properties of integer exponents.

Scientific Notation 8.1.1.5	• **Scientific notation** is a method of approximating very large and very small numbers. • Different technologies represent scientific notation in different forms. • Properties of exponents can be used to perform operations on with numbers expressed in scientific notation.	• Convert between standard and scientific notation of numbers. • Compare and order numbers written in scientific notation. • Recognize and interpret results when using technology to operate on number written in scientific notation.

	• With physical measurements, **Significant Digits** are each of the digits of a number that are used to express it to the required degree of accuracy, starting from the first nonzero digit.
	  ○ *All non-zero digits are significant.*
	  ▪ *34.562 has five significant digits.*
	  ○ *All zeroes between significant digits are significant.*
	  ▪ *34.05062 has seven significant digits.*
	  ○ *All zeroes to the right of the decimal point **and** to the right of significant digits are sometimes significant.*
	  ▪ *.00345620 has six signficant digits.*
	  ○ *Zeros after a non-zero digit without a decimal place are not significant.*
	  ▪ *93,400 has three significant digits.*
		• Work with significant digits.
		• Perform operations (multiplication and division only) on numbers written in scientific notation using the correct number of significant digits when physical measurements are involved.
		  ○ *$(4.2 \times 10^4) \times (8.25 \times 10^3) = 3.465 \times 10^8$, but if these numbers represent physical measurements, the answer should be expressed as 3.5×10^8 because the first factor, 4.2×10^4, only has two significant digits.*

	• Special rules follow when determining significant digits of products and quotients.
	  ○ *Represent the product or quotient using the least total number of significant digits in the factors or divisor/dividend, respectively.*
	  ▪ *9,243.58 (Six significant digits)*
	  x 0.507 (Three significant digits)
	  4,690 (Three significant digits)
	• Digits that are not significant does not imply they are not important, these digits are used as place holders to show a numbers true value.	

Represent & Solve Equations
 	
8.2.4.2
8.2.4.1
	Students will know that:
	• An **equation** is a number, a variable or a combination of both that includes an equal sign.
	• **Properties of Equality** and **Inverse Operations** can be used to isolate a variable when solving an algebraic equation.
	  ○ ***Reflexive**: $a = a$*
	  ○ ***Transitive**: If $a = b$, and $b = c$, then $a = c$*
	  ○ ***Addition**: If $a = b$, then $a + c = b + c$*
	  ○ ***Subtraction**: If $a = b$, then $a - c = b - c$*
	  ○ ***Multiplication**: If $a = b$, then $ac = ab$*
	  ○ ***Division**: If $a = b$, then $a \div c = b \div c$*
	  ○ ***Additive Inverse:** $a + (-a) = 0$*
	  ○ ***Multiplicative Inverse:** $a \cdot \frac{1}{a} = 1$*
		Student will be able to:
		• Solve multi-step equations in one variable.
		• Solve equations, in one variable, with variables on both sides.
		• Solve for one variable in a multi-variable equation in terms of other variables (**Literal Equations**/**Formulas**).
		• Justify the steps by identifying Properties of Equality used.

	• An equation is **linear** if it creates a straight, non-vertical line when plotted on a coordinate plane.	• Plot a set of ordered pairs and surmise a reasonable graph of which the points are a part. • Use linear equations to represent situations involving a constant rate of change, including proportional and non-proportional relationships. ○ *For a cylinder with a fixed radius of length 5, the surface area $A = 2\pi(5)h + 2\pi(5)^2$, is a linear function of the height h, but the surface area is not proportional to the height.*
Essential Vocabulary: Real, Imaginary, Rational, Irrational, Integer, Whole, Natural, Exponent, Equivalent, Scientific Notation, Significant Digit, Properties of Algebra, Associative, Commutative, Distributive, Order of Operations, Simplify, Evaluate, Radical, Variable, Algebraic/Numerical Expression, Literal Equation, Formula, Properties of Equality, Reflexive, Transitive, Addition, Subtraction, Multiplication, Division, Inverse Operations, Multiplicative Inverse, Additive Inverse, Linear Equation.		
Interim 1		

Unit 1: The Real Number System, Exponents and Scientific Notation, Expressions & Equations

Time Frame	Topic	Suggested Activities/Assessments	Resources & Text Alignment
Week 1	Pre-test		
Week 1 – Week 2	Real Numbers 8.1.1.1 8.1.1.2 8.1.1.3	Extension: Estimating Roots to the Nearest Hundredth: s:mathematicsresources:grade8	**HM Algebra 1** 1-5: Roots and Real Numbers (Ref. for ℝ only) 1-2: Adding and Subtracting Real Numbers 1-3: Multiplying and Dividing Real Numbers Resources Needed: ○ Compare/order real numbers ○ Locate real numbers on a number line.
Week 3	Simplify & Evaluate 8.2.3.2 8.2.3.1	HM Algebra 1 Evaluate Expressions pg. 12 Connect Algebra & Geometry pg. 52	**HM Algebra 1** 1-1: Variables and Expressions 1-4: Powers and Exponents 1-7: Simplifying Expressions
Week 4 – Week 5	Exponents 8.1.1.4		**HM Algebra 1** 7-3: Multiplication Properties of Exponents 7-4: Division Properties of Exponents 7-5: Rational Exponents
Week 6 – Week 7	Scientific Notation 8.1.1.5	Significant Digits: http://www.purplemath.com/modules/rounding2.htm Significant Digits: s:mathematicsresources:Grade 8	**HM Algebra 1** 7-1: Integer Exponents 7-2: Power of 10 and Scientific Notation
Week 7 – Week 8	Represent & Solve Equations 8.2.4.2 8.2.4.1	HM Algebra 1 Solve Equations by Graphing pg. 91 Model Equations with Variables on Both Sides pg. 99	**HM Algebra 1** 2-1: Solving Equations by Adding or Subtracting 2-2: Solving Equations by Multiplying or Dividing 2-3: Solving Two-Step and Multi-Step Equations 2-4: Solving Equations with Variables on Both Sides 2-5: Solving for a Variable
Week 9	Review		
Week 10	Interim 1		

Overview

Strand(s): Algebra

Unit 2: Special Equations & Inequalities, Slopes & Lines

Approximate Duration of Study: 8 Weeks Between Interims.

MNSS	Knowledge	Skills

Absolute Value
 	
8.2.4.9
8.2.4.6
	Students will know that:
	• The **absolute value** is mathematical concept which cannot be defined using only one condition.
	• The absolute value of a linear expression can be used to model relationships in various contexts.
	  ○ *A cylindrical machine part is manufactured with a radius of 2.1 cm. with a tolerance of $\frac{1}{100}$ cm. The radius r satisfies the inequality $\|r - 2.1\| \leq 0.01$.*
	• **Absolute Value Equations** must be solved by exploring 2 cases: the negative case and the positive case.
	  ○ *For $\|x + 8\| = 12$, the value within the absolute value bars may have been positive or negative therefore the positive case: $x + 8 = 12$ and the negative case: $-(x + 8) = 12$ are solved to find $x = 4$ or $x = -20$.*
	  ○ *$\|x\| = c$, two solutions; $\|x\| = 0$, one solution; $\|x\| = -c$, no solution (the absolute value of any quantity cannot be a negative number).*
		Student will be able to:
		• Solve and justify procedures taken to solve problems involving absolute values.
		  ○ *Solve $\|2x - 3\| + 3x = 4x - 2$*
		• Explain why **extraneous solutions** are not solutions at all.
		  ○ *For the above equation, $x = \frac{5}{3}$ and $x = 1$, $x = \frac{5}{3}$ is the extraneous solution.*

	• Solutions to absolute value equations in one variable can be represented visually.	• Graph the solution set of absolute value equations on a number line.

Inequalities 8.2.4.4 8.2.4.5 8.2.4.6 (Absolute Value Inequalities)	**Students will know that:** • **Linear Inequalities** can be used to represent situations where there are infinitely many possibilities for the solution. • Properties of Inequality can be used to isolate a variable when solving an algebraic inequality. ○ *Addition: If $x < y$, then $x + z < y + z$, (similarly for >)* ○ *Subtraction: If $x < y$, then $x - z < y - z$, (similarly for >)* ○ *Multiplication and Division:* *If $x < y$, and $z > 0$, then $xz < yz$; if $x < y$, and $z < 0$, then $xz > yz$.* *If $x > y$, and $z > 0$, then $xz > yz$; if $x > y$, and $z < 0$, then $xz < yz$.* • Solutions to inequalities in one variable can be represented visually on a number line.	**Student will be able to:** • Use linear inequalities to represent relationships in various contexts. • Solve and graph the solution set of a linear inequalities.
	• **Absolute Value Inequalities** are solved by identifying the two conditions to be satisfied and solving their associated compound inequality. • Less-than symbols indicate an "AND" statement; greater-than symbols indicate an "OR" statement. ○ *$\|x\| < c \rightarrow -c < x < c$* ○ *$\|x\| > c \rightarrow x > c, x < -c$* ○ *Special Cases* ▪ *$\|x\| > -c$, all real number solutions.* ▪ *$\|x\| < -c$, no solution.* • Solutions to absolute value inequalities in one solution can be represented visually on a number line.	• Solve and graph the solution set of absolute value inequalities. ○ *A food manufacturer makes 32-oz boxes of pasta. Not every box weights exactly 32 oz. The allowable difference from the idea weight is at most 0.05 oz. The weight w satisfies the inequality $\|w - 32\| \leq 32$.*
Slopes & Lines 8.2.4.3 8.3.2.1 8.3.2.2 8.2.2.2 8.2.2.3	**Students will know that:** • The **slope** is a **constant rate of change** that measures the steepness of a line. The greater the slope, the steeper the line. ○ *slope (m) = $\frac{\Delta y}{\Delta x} = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1}$* • The relationship between two or more lines can be determined by comparing their slopes and **y-intercepts**. • Equations of lines can be found given: two **coordinate pairs** or one coordinate pair and the slope.	**Student will be able to:** • Find the slope of any line given two coordinate pairs. • Given sufficient information, find the equation of a line. ○ *Determine an equation of the line through the points (-1, 6) and ($\frac{2}{3}$, $-\frac{3}{4}$).* • Identify graphical properties of lines (slopes and intercepts). • Graph linear equations by find the x- and y-intercepts.

	• Linear Equations can be expressed using the following forms:
	  ○ *Slope-Intercept Form:* $y = mx + b$
	  ○ *Point-Slope Form:* $y - y_1 = m(x - x_1)$
	  ○ *Standard Form:* $Ax + By = C$
		• Convert between slope-intercept form and standard form (also point-slope to other forms) and vice-versa.

	• Parallel lines have the same slope. • Perpendicular lines have slopes that are opposite reciprocals. ○ A line with m = $\frac{2}{3}$ is perpendicular to a line with m = $-\frac{3}{2}$. • Technology can be used to examine the relationships between slopes of parallel or perpendicular lines.	• Identify parallel and perpendicular lines. • Write an equation of the line passes through a given point that is parallel or perpendicular to a given line.
	• Shapes, on a coordinate grid, can be identified by comparing the slopes of the lines that compare the shapes.	• Analyze **polygons** on a **coordinate system** by determining the slopes of their sides. ○ *Given the coordinates of four points, determine whether the corresponding quadrilateral is a parallelogram.*
	• The y-intercept is zero when the function represents a proportional relationship (**direct variation**). • A relationship between two variables, x and y, is proportional if it can be expressed in the form $y = kw$ or $\frac{y}{x} = k$ ($y = mx + b$ where $b = 0$). • The graph of a proportional relationship is a straight, non-vertical line passing through the origin on the Cartesian Plane.	• Solve and graph direct variation equations.
	• Changes to a graph can be related directly to the equation that describes the graph.	• Describe how changes in the slope and y-intercept affect the graph of a linear equation. • Use graphing technology to examine transformations of linear equations and their associated graphs.
Essential Vocabulary: Square Root, Cube Root, Absolute Value Equations, Linear Inequality, Properties of Inequalities, System of Linear Inequalities, Conditions, Solution of a System, Extraneous Solutions, Slope, Constant Rate of Change, Y-Intercept, Coordinate Pair, Polygon, Coordinate System, Direct Variation.		
Interim 2		

Pacing Chart

Unit 2: Special Equations & Inequalities, Slopes & Lines

Time Frame	Topic	Suggested Activities/Assessments	Resources & Text Alignment
Week 11 – Week 12	Absolute Value 8.2.4.9 8.2.4.6		**HM Algebra 1** 2-6: Solving Absolute Value Equations
Week 13 – Week 15	Inequalities 8.2.4.4 8.2.4.5 8.2.4.6 (Absolute Value Inequalities)		**HM Algebra 1** 3-1: Graphing and Writing Inequalities 3-2: Solving Inequalities by Adding or Subtracting 3-3: Solving Inequalities by Multiplying or Dividing 3-4: Solving Two-Step and Multi-Step Inequalities 3-5: Solving Inequalities with Variables on Both Sides 3-6: Solving Compound Inequalities 3-7: Solving Absolute-Value Inequalities
Week 16 – Week 17	Slopes & Lines 8.2.4.3 8.3.2.1 8.3.2.2 8.2.2.2 8.2.2.3	HM Algebra 1 Explore Constant Changes pg. 322 Graph Linear Functions pg. 359 Family of Linear Functions pg. 368	**HM Algebra 1** 5-3: Rate of Change and Slope 5-4: The Slope Formula 5-7: Slope-Intercept Form 5-8: Point-Slope Form 5-9: Slopes of Parallel and Perpendicular Lines 5-6: Direct Variation 5-10: Transforming Linear Functions
Week 18	Review		
Week 19	Interim 2		

Overview

Strand(s): Algebra

Unit 3: Functions and Systems

Approximate Duration of Study: 9 Weeks Between Interims.

MNSS	Knowledge	Skills
Functions 8.2.1.1 8.2.1.2 8.2.2.1	**Students will know that:** • A **function** is a relationship between an **independent** variable and a **dependent** variable in which the value of the independent variable determines the value of the dependent variable. • The graph of a function is the set of ordered pairs where each value of the **input** is associated with a unique value of the **output**. • A **relation** is any set of ordered pairs. • The **domain** is the set of all possible values for the input (independent variable) of a relation or function. The **range** is the set of all the possible values for the output (dependent variable) of a relation or function. • **Function Notation**, ***f(x)***, can be used to represent relationships.	**Student will be able to:** • Determine if a set of ordered pairs, a table, or a graph represents a function. • Write and use function notation to evaluate functions for inputs in their domains. • Interpret statements that use function notation in terms of a context. ○ *The relationship between the area of a square* and the side length can be expressed as $f(x) = x^2$. *In this case, $f(5) = 25$, which represents the fact that a square of side length 5 units has an area of 25 units squared.* • Select the appropriate domain to represent a given situation. • Graph a function within a given domain and range. • Create a reasonable table of ordered pairs from a given function rule, plot the points, and surmise its graph.

	• A **Linear Function** has an associated straight, non-vertical graph.
	  ○ No greater than an exponent of 1 on any variable.
	• Linear functions represent relationships in which changing the input variable by some amount leads to a change in the output variable that is a constant times that amount.
	  ○ *Uncle Jim gave Emily $50 on the day she was born and $25 on each birthday after that. The function $f(x) = 50 + 25x$ represents the amount of money Jim has given after x years. The rate of change is $25 per year.*
		• Distinguish between the graphs of linear, **quadratic**, **cubic**, absolute value, and **exponential** functions.
		• Write a function to represent a linear relationship between two quantities.

	• Linear Functions can be represented with tables, verbal descriptions, symbols, equations and graphs.	• Translate from one linear function representation to another.

Linear Functions
 	
8.2.1.3
8.2.1.4
8.2.2.4
	Students will know that:
	• A linear function is defined by the equation $f(x) = mx + b$ and its graph is a straight line.
	  ○ *The function $f(x) = x^2$ is not a linear function because its graph contains the points (1, 1), (-1, 1) and (0,0), which are not on a straight line.*
	• A function is increasing when x is increasing and y is increasing.
	• A function is decreasing when x is increasing and y is decreasing..
	• Visual and numerical patterns can be represented with a linear function.
	• An **Arithmetic Sequence** is a linear function that can be expressed in the form $f(x) = mx + b$, where x = 0, 1, 2, 3, …
	  ○ *The arithmetic sequence 3, 7, 11, 15 can be expressed as $f(x) = 4x + 3$.*
		Student will be able to:
		• Use function notation to represent linear relationships.
		• Identify if a function is linear or nonlinear.
		• Determine the functional relationship between two quantities by analyzing a graph.
		• Recognize and extend an arithmetic sequence.
		• Find a given **term** of an arithmetic sequence.
		• Represent arithmetic sequences using equations, tables, graphs and verbal descriptions.
		• Solve problems involving arithmetic patterns.

Non-Linear Functions
 	
8.2.1.5
8.2.2.5
	Students will know that:
	• Visual and numerical patterns can be represented with non-linear functions.
	• A **Geometric Sequence** is a non-linear function that can be expressed in the form $f(x) = ab^x$, *where $x = 0, 1, 2, 3, \ldots$*
	  ○ *The geometric sequence 6, 12, 24, 48, …, can be expressed in the form $f(x) = 6(2^x)$*
	• Compound Interest models a geometric sequence.
	  ○ *Compound Interest Formula: $A = P(1 + \frac{r}{n})^{nt}$*
		Student will be able to:
		• Recognize and extend a geometric sequence.
		• Find the **nth** term of a geometric sequence.
		• Represent geometric sequences using equations, tables, graphs and verbal descriptions.
		• Solve problems involving geometric patterns.
		  ○ *If a girl invests $100 at 10% annual interest, she will have $100(1.1)^x$ dollars after x years.*

Systems
 	
8.2.4.7
8.2.4.8
	Students will know that:
	• A **system** is a set of two or more linear equations containing two or more variables.
	• A **solution** to a system is the coordinate pair that satisfies all equations of the system.
	• Systems can be solved symbolically, graphically and numerically.
	  ○ *A system with 0 solutions produces parallel lines.*
	  ○ *A system with 1 solution produces intersecting lines.*
	  ○ *A system with infinite solutions produces **coincident lines**.*
	• A system can be solved by substitution, elimination or by graphing.
	• The points of intersections of two graphs are simultaneous solutions of the relations that define them.
		Student will be able to:
		• Represent relationships in various contexts using systems of linear equations.
		• Determine the number of solutions that a system may have by inspection or by analyzing the graph.
		• Solve systems of linear equations.
		  ○ *Marty's cell phone company charges $15 per month plus $0.04 per minute for each call. Jeannine's company charges $0.25 per minute. Use a system of equations to determine the advantages of each plan based on the number of minutes used.*
		• Solve and list approximate numerical solutions to systems.
		• Solve a system of two linear equations in two variables algebraically and interpret the answer graphically.
		• Check whether a pair of numbers satisfies a system of two linear equations in two unknowns by substituting the numbers into both equations.

	• A system of linear inequalities can be graphed on the coordinate plane. • The solution to a system of linear inequalities is the region where the graphs of the individual inequalities overlap. • The **boundary line** representing the graph of an inequality may be either dashed or solid.	• Solve a **system of two linear inequalities** in two variables and sketch the solution set. • Explain the meaning of the solution set to a linear inequality or system of linear inequalities.
Essential Vocabulary: Function, Function Notation, Vertical Line Test, Independent, Dependent, Input, Output, Domain, Range, Linear Function, Quadratic, Cubic, Exponential, Sequence, Arithmetic Sequence, Term, Common Difference, Common Ratio, N^{th}, System of Equations, System of Inequalities, Coincident Lines, Consistent System, Inconsistent System, Independent System, Dependent System, Solution to a System, Boundary Line.		
Interim 3		

Pacing Chart

Unit 3: Slopes, Lines, Functions, and Systems

Time Frame	Topic	Suggested Activities/Assessments	Resources & Text Alignment
Week 20 – Week 21	Functions 8.2.1.1 8.2.1.2 8.2.2.1		**HM Algebra 1** 1-8: Introduction to Functions 4-1: Graphing Relationships 4-2: Relations and Functions 4-3: Writing Functions 4-4: Graphing Functions
Week 22	Linear Functions 8.2.1.3 8.2.1.4 8.2.2.4		**HM Algebra 1** 5-1: Identifying Linear Functions 4-6: Arithmetic Sequences
Week 23 – Week 24	Non-Linear Functions 8.2.1.5 8.2.2.5		**HM Algebra 1** 11-1: Geometric Sequences 11-3: Exponential Growth and Decay *Compound Interest only*
Week 25 – Week 26	Systems 8.2.4.7 8.2.4.8	HM Algebra 1 Solve Linear Equations by Using a Spreadsheet pg. 396 Model Systems of Linear Equations pg. 403 Solving Classic Problems pg. 418 Solve Systems of Linear Inequalities pg. 435	**HM Algebra 1** 6-1: Solving Systems by Graphing 6-2: Solving Systems by Substitution 6-3: Solving Systems by Elimination 6-4: Solving Special Systems 6-5: Solving Linear Inequalities 6-6: Solving Systems of Linear Inequalities
Week 27 – Week 28	Review		
Week 29	Interim 3		

Overview

Strand(s): Algebra, Geometry & Measurement, Data analysis & Probability

Unit 4: Trend Lines, Pythagorean Theorem and Intro to Algebra 1B

Approximate Duration of Study: 6 Weeks Between Interims.

MNSS	Knowledge	Skills
Trend Lines 8.4.1.1 8.4.1.2 8.4.1.3	**Students will know that:** • A **scatter plot** is a graph that relates two different sets of data by displaying them as ordered pairs. • Scatter plots can be used to find trends in data. • The shape of the graph indicates the **correlation** between the data. • Lines are widely used to model relationships between two quantitative variables. • The closer each point is to the **Line of Best Fit**, the better the fit. • Graphing technology computes the equation of the line of fit using a method called **Linear Regression**.	**Student will be able to:** • Collect, display and interpret data using scatterplots. ○ Use appropriate titles, labels and units • Use the shape of the scatterplot to informally estimate a line of best fit. • Determine an equation for the line of best fit. • Use graphing technology to display scatterplots and corresponding lines of best fit.

	• The line of best fit can be used to estimate or predict values.	• Use a line of best fit to make statements about approximate rate of change.
		• Make predictions about values not in the original data set.
		  ○ *Given a scatterplot relating student heights to shoe sizes, predict the shoe size of a 5'4" student, even if the data does not contain information for a student of that height.*
		• Asses the reasonableness of predictions using scatterplots by interpreting them in the original context.
		  ○ *A set of data may show that the number of women in the U.S. Senate is growing at a certain rate each election cycle. Is it reasonable to use this trend to predict the year in which the Senate will eventually include 1000 female Senators?*

Pythagorean Theorem
 	
8.3.1.1
8.3.1.2
8.3.1.3
	Students will know that:
	• **Pythagorean Theorem:**
	  ○ ***$a^2 + b^2 = c^2$,*** *where a and b are* ***legs*** *and c is the* ***hypotenuse.*** *The sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.*
	• **Converse** of the Pythagorean Theorem
	  ○ *If the sum of the squares of the two shorter sides of a triangle is equal to the square of its longest side, then it is a right triangle.*
		Student will be able to:
		• Use Pythagorean Theorem to solve problems involving **right triangles**.
		  ○ *Determine the **perimeter** of a right triangle, given the lengths of two of its sides.*
		  ○ *Show that a triangle with side lengths 4, 5,and 6 is not a right triangle.*
		• Solve problems involving the converse of the Pythagorean Theorem.
		• Use irrational numbers to represent lengths.

	• The Pythagorean Theorem can be used to find the distance between any two points in a coordinate plane. ○ Distance Formula: $d = \sqrt{(x_1 - x_2)^2 + (y_2 - y_1)^2}$	• Find the distance between two points on a horizontal, vertical or diagonal line in a coordinate system.
	• The Pythagorean Theorem can be informally justified by using measurements, diagrams and computer software.	• Prove and explain the proof of the Pythagorean Theorem. ○ *Bhaskara, Chinese Square, Garfield.*

Intro to Algebra 1B Standards
 	
Polynomials
 	
9.2.3.2a
9.2.3.3
 	
(Not assessed via MCAs)
	Students will know that:
	• A **monomial** is a real number, a variable or a product of a real number and one or more variables with whole number exponents.
	• A **degree** of a monomial is the sum of the exponents of its variables.
	  ○ *The degree of a nonzero constant is 0.*
	  ○ *Zero has no degree*
	• A **polynomial** is a monomial or a sum of monomials.
		Student will be able to:
		• Write polynomials in standard form.
		• Classify polynomials.
		  ○ *$-2x^3 + 4x^5 + 3x^4$ is a Quintic Trinomial.*

	• Properties of Algebra can be used to rearrange and combine like terms of polynomials.	• Add and subtract polynomials.

	• Various methods can be used to multiply polynomials.
	• Extension: Some special cases, within polynomial multiplication, are easy to identify and have a pattern to their products.
	  ○ $(a + b)^2 = a^2 + 2ab + b^2$
	  ○ $(a - b)^2 = a^2 - 2ab + b^2$
	  ○ $(a + b)(a - b) = a^2 - b^2$
		• Use Distributive Property, a table or stacking to multiply polynomials.
		• Extension: Multiply special cases.
		  ○ Stacking: $3x^2 - 5x + 3$
		$2x - 2$
		$-6x^2 + 10x - 6$
		$+ (6x^3 - 10x^2 + 6x)$
		$6x^3 - 16x^2 + 16x - 6$

	• Factoring a polynomial reverses the multiplication process. • Polynomials can be factored to yield expressions that are simpler to manipulate and make equation solving easier.	• Factor second- and higher-degree polynomials when standard techniques apply. ○ Factor GCF, grouping, (extension: special binomial cases, difference of two squares, perfect square trinomials). • Factor trinomials using the Factor/Sum or Box Methods.

Intro to Algebra 1B Standards
 	
Quadratics
9.2.1.5a
(Standard Form Only)
9.2.1.6
9.2.1.9
9.2.2.1
9.2.2.3
(Quadratics)
 	
(Not assessed via MCAs)
	Students will know that:
	• A quadratic polynomial can be used to define a **quadratic function**.
	  ○ *Written as $y = ax^2 + bx + c$ in standard form.*
	  ○ ***Parent function**: $y = ax^2$, where $a = 1$.*
	• A quadratic function is a nonlinear function that models situations where the rate of change is not constant.
	• The graph of a quadratic function is a symmetric curve with a highest or lowest point corresponding to a **maximum** or **minimum** value.
	  ○ *For $y = ax^2 + bx + c$ if $a > 0$ (positive), the function has a minimum; if $a < 0$ (negative), the function has a maximum.*
		Student will be able to:
		• Identify and graph a quadratic function.
		• Determine if a quadratic function has a maximum or minimum.
		• Determine the equation of the **axis of symmetry**.
		• Determine the coordinates of the **vertex**.
		  ○ *X-coordinate of the vertex: $x = \frac{-b}{2a}$*
		• Determine the **domain** and **range** of a quadratic function.
		• Identify **intervals of increase and decrease**.
		• Explain the effect that changing the values of *a* and *c* has on the graph of a quadratic function.

	• The **zeroes** (roots) of a quadratic function are the solutions to the function (x-intercepts).
	• **Quadratic Formula** is used to find the zeroes of a quadratic function.
	  ○ $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$
	• The **discriminant** is used to determine the number of solutions a quadratic function has.
	  ○ *$b^2 - 4ac > 0$; the function has 2 real solutions.*
	  ○ *$b^2 - 4ac = 0$; the function has 1 real solution.*
	  ○ *$b^2 - 4ac < 0$; the function has no real solutions.*
		• Solve quadratic functions in one variable.
		  ○ By factoring, graphing, using square roots, or **completing the square***, or using the quadratic formula.
		• Use squaring to solve problems that lead to quadratic equations.
		• Clear fractions to solve equations that lead to linear or quadratic equations.
		  ○ $\sqrt{3x+4} = x$
		• Use the **zero product property** to reveal the zeroes of a quadratic function.
		• Complete the square to write a quadratic expression as the difference of two squares*.
		• Graph quadratic functions by completing the square to find the vertex*.

	• **Square roots** and **cube roots** are inverse operations of x^2 and x^3,	**Completing the Square is an extension.*

	respectively.	• Solve and justify procedures taken to solve problems involving squares and square roots, cubes and cube roots. ○ *If $\pi x^2 = 5$ then $\lvert x \rvert = \sqrt{\frac{5}{\pi}}$, or equivalently, $x = \sqrt{\frac{5}{\pi}}$ or $-\sqrt{\frac{5}{\pi}}$. If x is understood as the radius of a circle in this example, then the negative solution should be discarded and $x = \sqrt{\frac{5}{\pi}}$.*
Essential Vocabulary: Scatter Plot, Positive Correlation, Negative Correlation, No Correlation, Trend Line, Line of Best Fit, Linear Regression, Pythagorean Theorem, Legs, Hypotenuse, Distance Formula, Monomial, Degree, Polynomial, Constant, Quadratic, Cubic, Quartic, Quintic, N^{th} Degree, Stacking, Quadratic Function, Parent Function, Maximum, Minimum, Zeroes, Roots, Axis of Symmetry, Vertex, Domain, Range, Interval of Increase/Decrease, Completing the Square, Zero Product Property, Quadratic Formula, Discriminant.		
Interim 4		

Pacing Chart

Unit 4: Trends, Pythagorean Theorem and Intro to Algebra 1B

Time Frame	Topic	Suggested Activities/Assessments	Resources & Text Alignment
Week 30	Trend Lines 8.4.1.1 8.4.1.2 8.4.1.3	HM Algebra 1 Technology Lab: Interpret Scatter Plots and Trend Lines pg. 274 Connecting Algebra to Data Analysis pg. 275	**HM Algebra 1** 4-5: Scatter Plots and Trend Lines
Week 30	Pythagorean Theorem 8.3.1.1 8.3.1.2 8.3.1.3	Pythagorean Theorem s:mathematicsresources:grade8	Resources Needed: ○ Square Roots and Cube Roots *Extension: Cubes and Cube Roots*
Week 31	Grade Level Review		
Week 32	Mathematics MCAs		
Begin in Week 30 Week 33 – Week 34	Intro to Algebra 1B Standards Polynomials (Not assessed via MCAs)	HM Algebra 1 Model Polynomial Addition and Subtraction pg. 502 Model Polynomial Multiplication pg. 510 **Connect Algebra to Geometry pg. 520** Model Factoring pg. 550 Model Factorization of Trinomials pg. 558 Use a Graph to Factor Polynomials pg. 575 Connect Algebra to Number Theory pg. 585	**HM Algebra 1** 7-6: Polynomials 7-7: Adding and Subtracting Polynomials 7-8: Multiplying Polynomials *Extension: 7-9: Special Products of Binomials* 8-1: Factors and Greatest Common Factors 8-2: Factoring by GCF 8-3: Factoring $x^2 + bx + c$ 8-4: Factoring $ax^2 + bx + c$ *Extension: 8-5: Factoring Special Products* *Extension: 8-6: Choosing a Factoring Method*
Week 34 – Week 35	Intro to Algebra 1B Standards Quadratics (Not assessed via MCAs)	HM Algebra 1 Explore the Axis of symmetry pg. 618 The Family of Quadratic Functions pg. 632 Explore Roots, Zeros, and x-intercepts pg. 648 Model Completing the Square pg. 662	**HM Algebra 1** 9-1: Identifying Quadratic Functions 9-2: Characteristics of Quadratic Functions 9-3: Graphing Quadratic Functions 9-5: Solving quadratic Equations by Graphing 9-6: Solving Quadratic Equations by Factoring 9-7: Solving Quadratic Equations by Using Square Roots 9-9: The Quadratic Formula and the Discriminant *Extension: 9-4: Transforming Quadratic Functions* *Extension: 9-8: Completing the Square*
Week 35	Review		
Week 36	Interim 4		