ALGEBRA 1 - SJPS Curriculum

Year at a Glance
(2013-2014)

Name of Unit	Learning Goals	Knowledge & Skills
UNIT 1: Relationships Between Quantities and Reasoning with Equations (35 days?)	·	·
UNIT 2: Linear and Exponential Relationships (45 days?)	·	
UNIT 3: Expressions and Equations (30 days?)	·	·
UNIT 4: Quadratic Functions (30 days?)	·	·
UNIT 5: Descriptive Statistics (20 days?)	·	·

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Unit 1: Relationships between Quantities and Reasoning with Equations

Unit overview: (Narrative description of unit purpose)
Students, through reasoning, develop fluency writing, interpreting, and translating between various forms of linear equations and inequalities, and make conjectures about the form that a linear equation might take in a solution to a problem. They reason abstractly and quantitatively by choosing and interpreting units in the context of creating equations in two variables to represent relationships between quantities. They master the solution of linear equations and apply related solution techniques and the properties of exponents to the creation and solution of simple exponential equations.

Learning Goals:

1. Students will master, analyze and explain the process of solving an equation.
2. Students will write and graph all forms of linear equations and inequalities.
3. Students will interpret and translate between various forms of linear equations and inequalities (including graphs and tables)
4. Students will make conjectures showing a linear equation is an effective solution to a problem.
5. Students will write and create equations with two variables to represent quantities.
6. Students will create and solve simple exponential equations.

Instructional Strategies and Structures:
Marzano 9?

Time Span: (Length of Unit)
About 35 days

Assessment: (Methods used for formative and summative)
exit slips
quizzes/test
summative exam

Vocabulary and Key Concepts

Integers	Absolute Value	Linear equation
x-intercept	y-intercept	Solution of a linear equation
rate of change -- slope	slope-intercept form	rise

run	Standard form	perpendicular lines
point-slope form	Inequality	Compound Inequality
Solution of an inequality	solution set	graph of an inequality
absolute value inequality	linear inequality in two variables	solution to a linear inequality
graph of a linear inequality	half-planes	

Unit 1: Relationships between Quantities and Reasoning with Equations

Common Core State Standards or Michigan Content Expectations
Reason quantitatively and use units to solve problems.

- CCSS.Math.Content.HSN-Q.A.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.
- CCSS.Math.Content.HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
- CCSS.Math.Content.HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Create equations that describe numbers or relationships.

- CCSS.Math.Content.HSA-CED.A.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.*
- CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- CCSS.Math.Content.HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
- CCSS.Math.Content.HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Understand solving equations as a process of reasoning and explain the reasoning.

- CCSS.Math.Content.HSA-REI.A.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.

Solve equations and inequalities in one variable.

- CCSS.Math.Content.HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Unit 2: Linear and Exponential Relationships

Unit overview: (Narrative description of unit purpose)

Students will learn function notation and develop the concepts of domain and range. They explore many examples of functions, including sequences; they interpret functions given graphically, numerically, symbolically, and verbally, translate between representations, and understand the limitations of various representations. 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. Students explore systems of equations and inequalities, and they find and interpret their solutions. They interpret arithmetic sequences as linear functions and geometric sequences as exponential functions. In building models of relationships between two quantities, students analyze the key features or table of a function.

Learning Goals:

1. Students will learn function notation and develop the concepts of domain and range
2. Students will explore many examples of functions, including sequences
3. Students will interpret functions given graphically, numerically, symbolically, and verbally, translate between representations
4. Students will solve, graph and create tables for exponential functions with integer domains.
5. Students will compare exponential and linear functions
6. Students will explore systems of equations and inequalities, and they find and interpret their solutions.

Instructional Strategies and Structures:

Marzano 9?

Time Span: (Length of Unit)

About 45 days

Assessment: (Methods used for formative and summative)

Vocabulary and Key Concepts

systems of linear equations	Solution of a system of linear equations	Systems of linear inequalities
Solution of a system of linear inequalities	Graph of a system of linear inequalities	Function
Domain	Range	Independent Variable
Dependent Variable	Relation	Vertical Line Test (VLT)
Discrete Domain	Continuous Function	LInear Function
Function Notation	Piecewise Function	Step Function
Absolute value function	Nonlinear function	Sequence
Term	Arithmetic Sequence	Common Difference
Closed Set	nth root	exponential function
exponential growth	exponential growth function	compound interest
exponential decay	exponential decay function	geometric sequence
common ratio	recursive	maximum
minimum	critical points	extrema

Unit 2: Linear and Exponential Relationships

Common Core State Standards or Michigan Content Expectations

Solve systems of equations.

- CCSS.Math.Content.HSA-REI.C.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- CCSS.Math.Content.HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Represent and solve equations and inequalities graphically.

- CCSS.Math.Content.HSA-REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- CCSS.Math.Content.HSA-REI.D.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.▫
- CCSS.Math.Content.HSA-REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Understand the concept of a function and use function notation.

- CCSS.Math.Content.HSF-IF.A.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 *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*).
- CCSS.Math.Content.HSF-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- CCSS.Math.Content.HSF-IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.*

Interpret functions that arise in applications in terms of the context.

- CCSS.Math.Content.HSF-IF.B.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. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*▫
- CCSS.Math.Content.HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*▫
- CCSS.Math.Content.HSF-IF.B.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.▫

Analyze functions using different representations.

- CCSS.Math.Content.HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.▫
    - CCSS.Math.Content.HSF-IF.C.7a Graph linear and quadratic functions and show intercepts, maxima, and minima.
- CCSS.Math.Content.HSF-IF.C.9 Compare properties of two functions each

represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

Build a function that models a relationship between two quantities.

- CCSS.Math.Content.HSF-BF.A.1 Write a function that describes a relationship between two quantities.
    - CCSS.Math.Content.HSF-BF.A.1a Determine an explicit expression, a recursive process, or steps for calculation from a context.

Build new functions from existing functions.

- CCSS.Math.Content.HSF-BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\ f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Construct and compare linear, quadratic, and exponential models and solve problems.

- CCSS.Math.Content.HSF-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
    - CCSS.Math.Content.HSF-LE.A.1a Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
    - CCSS.Math.Content.HSF-LE.A.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
    - CCSS.Math.Content.HSF-LE.A.1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- CCSS.Math.Content.HSF-LE.A.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).

- CCSS.Math.Content.HSF-LE.A.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.

Interpret expressions for functions in terms of the situation they model.

- CCSS.Math.Content.HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.

Unit3: Expressions and Equations

Unit 3 Expressions and Equations

Unit overview: (Narrative description of unit purpose)
Students strengthen their ability to discern structure in exponential expressions. They understand that polynomials form a system analogous to the integers. In this modules' modeling applications, students reason abstractly and quantitatively in interpreting parts of an expression that represent a quantity in terms of its contest; they also learn to make sense of problems and persevere in solving them by choosing or producing equivalent forms of an expression.

Learning Goals:

1. Students will see how polynomial properties are similar to numerals including rational and irrational contexts
2. Students will write expressions in equivalent forms to solve problems
3. Students will perform operations on polynomials
4. Students will understand the relationship between zeros and factors of polynomials
5. Students will be able to factor polynomials

Instructional Strategies and Structures:
Marzano 9?

Time Span: (Length of Unit)

About 30 days

Assessment: (Methods used for formative and summative)

Vocabulary and Key Concepts

terms	factors	coefficients
monomial	zeros	degree
binomial	Trinomial	polynomial
		FOIL
factored form	zero-product property	root
factoring by grouping	prime polynomial	Rational

Unit 3:

Common Core State Standards or Michigan Content Expectations

Use properties of rational and irrational numbers.

- CCSS.Math.Content.HSN-RN.B.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.

Interpret the structure of expressions.

- CCSS.Math.Content.HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.▫
    - CCSS.Math.Content.HSA-SSE.A.1a Interpret parts of an expression, such as terms, factors, and coefficients.
    - CCSS.Math.Content.HSA-SSE.A.1b Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.*

- CCSS.Math.Content.HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$.

Write expressions in equivalent forms to solve problems.

- CCSS.Math.Content.HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.▫
    - CCSS.Math.Content.HSA-SSE.B.3a Factor a quadratic expression to reveal the zeros of the function it defines.
    - CCSS.Math.Content.HSA-SSE.B.3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
    - CCSS.Math.Content.HSA-SSE.B.3c Use the properties of exponents to transform expressions for exponential functions. *For example the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*

Perform arithmetic operations on polynomials.

- CCSS.Math.Content.HSA-APR.A.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Understand the relationship between zeros and factors of polynomials.

- CCSS.Math.Content.HSA-APR.B.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Create equations that describe numbers or relationships.

- CCSS.Math.Content.HSA-CED.A.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.*
- CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- CCSS.Math.Content.HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Solve equations and inequalities in one variable.

- CCSS.Math.Content.HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- CCSS.Math.Content.HSA-REI.B.4 Solve quadratic equations in one variable.
    - CCSS.Math.Content.HSA-REI.B.4a Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
    - CCSS.Math.Content.HSA-REI.B.4b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), 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 $a \pm bi$ for real numbers a and b.

Unit 4: Quadatic Functions

Unit overview: (Narrative description of unit purpose)

Students 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. They create and solve equations involving quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function. Students expand their experience with functions to include more specialized functions -- absolute value, step, and those that piecewise defined. Students select from among these functions to model phenomena using the modeling cycle.

Learning Goals:

1. Students will solve equations involving quadratic and cubic equations.
2. Students will be able to graph quadratics and find critical points.
3. Students will be able to solve quadratics by graphing, square roots, completing the square, and the quadratic formula.
4. Students will be able to graph and solve square root equations.
5. Students will be able to use the Pythagorean Theorem.

Instructional Strategies and Structures:

Time Span: (Length of Unit)

About 30 days

Assessment: (Methods used for formative and summative)

Vocabulary and Key Concepts

quadratic function	parabola	vertex
axis of symmetry	focus	zero
maximum value	minimum value	vertex form
quadratic equation	completing the square	quadratic formula
discriminant	square root function	simplest form of a quadratic expression
rationalizing the	conjugates	square root equation

denominator		
extraneous solutions	theorem	legs
hypotenuse	Pythagorean Theorem	distance formula
domain	range	

Unit 4:

Common Core State Standards or Michigan Content Expectations

Reason quantitatively and use units to solve problems.

CCSS.Math.Content.HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Create equations that describe numbers or relationships.

- CCSS.Math.Content.HSA-CED.A.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.*
- CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Interpret functions that arise in applications in terms of the context.

- CCSS.Math.Content.HSF-IF.B.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. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*
- CCSS.Math.Content.HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*
- CCSS.Math.Content.HSF-IF.B.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.

Construct and compare linear, quadratic, and exponential models and solve problems.

- CCSS.Math.Content.HSF-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
    - CCSS.Math.Content.HSF-LE.A.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
    - CCSS.Math.Content.HSF-LE.A.1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Unit 5: Descriptive Statistics

Unit overview: (Narrative description of unit purpose)
Students display and interpret graphical representations of data, and if appropriate, choose regression techniques when building a model that approximates a linear relationship between quantities. They analyze their knowledge of the context of a situation to justify their choice of a linear model. With linear models, they plot and analyze residuals to informally assess the goodness of fit.

Learning Goals:

1. Students will represent data with dot plots, histograms, and box plots.

2. Students will find and compare center (mean, median, mode) and spread (interquartile range, range, standard deviation) of two or more data sets.
3. Students will compare shapes of graphs (center, shape, spread, and outliers).
4. Students will summarize data from two way tables interpreting relative frequencies in the context of the data and recognize trends.
5. Students will use scatterplots to fit a function to the data (linear, quadratic, and exponential), informally assess the fit (using correlation coefficients), and fit a linear function.
6. Students will interpret the slope and intercept of a line model in the context of the data.
7. Students will compute and interpret the correlation coefficient of a linear fit.
8. Students will distinguish between correlation and causation.

Instructional Strategies and Structures:

Marzano 9?

Time Span: (Length of Unit)

About 20 days

Assessment: (Methods used for formative and summative)

Vocabulary and Key Concepts

measure of central tendency	dot plots	histograms
box plot	mean, median, mode	measures of dispersion
range, interquartile range	quartile	5 Number Summary
scatterplot	line of fit	residual
linear regression	line of best fit	correlation coefficient
causation	two-way table	joint frequency
marginal frequency		

Unit 5:

Common Core State Standards or Michigan Content Expectations

Summarize, represent, and interpret data on a single count or measurement variable

- CCSS.Math.Content.HSS-ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).
- CCSS.Math.Content.HSS-ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- CCSS.Math.Content.HSS-ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

Summarize, represent, and interpret data on two categorical and quantitative variables

- CCSS.Math.Content.HSS-ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
- CCSS.Math.Content.HSS-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
    - CCSS.Math.Content.HSS-ID.B.6a Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
    - CCSS.Math.Content.HSS-ID.B.6b Informally assess the fit of a function by plotting and analyzing residuals.
    - CCSS.Math.Content.HSS-ID.B.6c Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models

- CCSS.Math.Content.HSS-ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- CCSS.Math.Content.HSS-ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.
- CCSS.Math.Content.HSS-ID.C.9 Distinguish between correlation and causation.