A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Algebra I Scope and Sequence with NMSI's Laying the Foundation lessons

Unit 1: Functions
12 days of instruction plus assessment time-3 weeks

Unit Note: The first five lessons build upon each other and reference the skills from previous lessons within each new lesson. They are a part of the "Laying a Foundation for Functions" series. In order for students to thoroughly understand function notation and the associated vocabulary, it is best to complete the lessons in the order listed below.

NMSI's Laying the Foundation lesson: Introduction to Function Notation (1-2 day)- High School

Teacher Note: This lesson is a great introduction to functional notation and translating a verbal expression into functional notation. This short lesson teaches students to describe independent and dependent quantities. While it does not explicitly cover any common core standards, it is important for students to participate in this lesson in order to have a foundation of functions to build upon in future lessons.

**** Use Unit 1 Checkpoint: #1 after completing this lesson.**

NMSI's Laying the Foundation lesson: Connecting a Verbal Description to Table and Graph (2 days)- High School

Teacher Note: In this lesson, students use their knowledge of independent and dependent variables from the previous lesson to describe relationship between situations. Students will explore patterns by analyzing a table of values to create a general function rule for a modeling situation. They will analyze a graph and answer questions about a modeling situation.

AL COS	Common Core Standard	Common Core
Algebra I 13	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	A-CED2
Algebra I 4	Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	N-Q1 Partial

NMSI's Laying the Foundation lesson: Use Tables and Graphs to Determine the Better Deal (2 days)- High School

Teacher Note: In this lesson, students extend their knowledge from previous lessons. Once again, students will be given a modeling situation and asked to create a table. They will analyze the table to find a mathematical pattern and write a function rule to model the situation. They will graph the table of values and analyze the graph. This lesson is an introduction to the rate of change and this concept will be covered more in depth in Unit 2.

AL COS	Common Core Standard	Common Core
Algebra I 13	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	A-CED2
8th Grade	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a	8-F4

14	description of a relationship or from two (*x,y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of linear function in terms of the situation it models and in terms of its graph or a table of values.	
Algebra I 7a	Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression such as terms, factors, and coefficients.	A-SSE1a

NMSI's Laying the Foundation lesson: Connecting Table Graph and Function Notation (2 days)- High School

Teacher Note: This lesson builds upon previous lessons to connect tables, graphs, and functional notation. The new concepts in this lesson are domain and formal functional notation.

**** Use Unit 1 Checkpoint: #2 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 26	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.	F-IF2
Algebra I 13	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	A-CED2
8th Grade 11	Understand that a function is a rule that assigns to each input ~~exactly~~ one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	8-F1
Algebra I 25	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*).	F-IF1
Algebra I 29	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.(linear)	F-IF5
Algebra I 22	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).	A-REI10
Algebra I 4	Choose and interpret the scale and the origin in graphs and data displays.	N-Q1 Partial

NMSI's Laying the Foundation lesson: Discrete and Continuous Data (2 days)- High School

Teacher Note: This lesson continues to review and build upon the concepts learned in the first four lessons. The new concept in this lesson is an introduction to range and to discrete and continuous data. This lesson does a good job with the Common Core standard where students will determine a reasonable domain for a function.

**** Use Unit 1 Checkpoint: #3 and #4 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 26	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.	F-IF2
Algebra I 13	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	A-CED2

Algebra I 29	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. (linear)	F-IF5
8th Grade 11 Algebra I 22	Understand that a function is a rule that assigns to each input ~~exactly~~ one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. 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).	8-F1 A-REI10
Algebra I 4	Choose and interpret the scale and the origin in graphs and data displays. (linear)	N-Q1 Partial

Teacher Led Instruction (1 day)

Teacher Note: There are many lessons that discuss step functions on Youtube and Teachertube. You can also google step functions and find information. This may be in Algebra I textbooks, but is probably found in the Algebra II or Precalculus textbooks. The following website has examples http://www.algebra-class.com/step-functions.html

AL COS	Common Core Standard	Common Core
Algebra I 31b	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph ~~square root, cube root, and piecewise-defined functions~~, including step functions and ~~absolute value functions.~~	F-IF7b Partial

Teacher Led Instruction (1 day)

Teacher Note: A lesson that addresses functions with different representations can be found at the following website http://www.insidemathematics.org/pdfs/algebra/sorting-functions/task.pdf
You could use graph C and its table to discuss relations that are not functions and cover standards 8th grade #11 and Algebra I #24. You might want to use some additional mapping questions and lists of ordered pairs from your textbook to emphasize relations that are not functions.
**** Use Unit 1 Checkpoint: #5 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th Grade 12	Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Example: Given a linear function represented by a table of values and linear function represented by an algebraic expression, determine which function has the greater rate of change.	8-F2
8th Grade 11	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	8-F1
Algebra I 25	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 $y = f(x)$.	F-IF1

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 2: Graphing and Analyzing Linear Functions
15 days of instruction plus assessment time-3 to 3.5 weeks

NMSI's Laying the Foundation lesson: Walk the Line (2 days)-Middle Grades

Teacher Note: This activity does a good job connecting the function sense with the idea of linear movement.

**** Use Unit 2 Checkpoint: #1 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th Grade 15	Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	8-F5 Partial
Algebra I 5	Define appropriate quantities for the purpose of descriptive modeling.	N-Q2
Algebra I 4	Choose and interpret units consistently in formulas and choose and interpret the scale and the origin in graphs and data displays. (linear)	N-Q1 Partial

NMSI's Laying the Foundation lesson: Average Rate of Change (a.k.a slope) (1 day)

Middle Grades

Teacher Note: This is a great lesson to introduce average rate of change and for students to practice analyzing a graph. Students are asked to look at a graph to identify the average speed and rate of change over a specified interval. Students may need a small introduction to how to write one variable inequalities with and without inclusion for the time intervals. ($0 \le t < 4$)

**** Use Unit 2 Checkpoint: #2 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 30	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.	F-IF6

NMSI's Laying the Foundation lesson: Calculating Average Rates of Change (1 day)-High School

Teacher Note: This is an excellent lesson to provide students real-world situations that model an average rate of change. Students are given a modeling situation and asked to determine the coordinate of the points described in the situation, use the difference quotient to calculate the average rate of change, and verbally explain their answers.

AL COS	Common Core Standard	Common Core
Algebra I 30	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.	F-IF6 Partial
Algebra I 4	Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas.	N-Q1 Partial
Algebra I 28	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 intervals where the function is increasing or decreasing.*	F-IF4 Partial

NMSI's Laying the Foundation lesson: Slope Investigation (2 days) High School

Teacher Note: Before completing this lesson, students should be able to find the rate of change between two points. In this lesson, students analyze a table and a graph to interpret the meaning of rate of change in a modeling situation. This lesson introduces the idea of 0 slope and undefined slope (horizontal and vertical lines) and introduces the slope-intercept form.

**** Use Unit 2 Checkpoint: # 3, #4, #5-#8 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 30	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.	F-IF6

NMSI's Laying the Foundation lesson: Analysis of Functions (2 days) High School

Teacher Note: This lesson allows students to look at various types of functions (linear, quadratic, piecewise, etc.) to determine the intervals of x where f(x) is increasing/decreasing, positive/negative, constant, or has positive/negative slope. Students will use inequalities to represent the intervals of increase or decrease. (Ex: $3<x<5$) Students may need a review or small introduction to how to write one variable inequalities with and without inclusion. A comprehensive study of solving inequalities will be addressed in Unit 4.

**** Use Unit 2 Checkpoint: #9-#13 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th Grade 15	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear).	8-F5 Partial
Algebra I 28	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, *Key features include intercepts; intervals where the function is increasing, decreasing, positive, or negative.*	F-IF4 Partial

NMSI's Laying the Foundation lesson: Translations of Linear Functions (2.5 days) High School

Teacher Note: This lesson explores translating the graphs of lines and relates the shift change to the form $y=m(x-h)+k$. This lesson creates a great foundation for students to build upon when analyzing the vertex form of a quadratic equation and will help them extend the meaning of translations of non-linear functions in later units. The teacher might need to work through #1 with the students to remind them of slope-intercept form and how to factor out a GCF.

AL COS	Common Core Standard	Common Core
Algebra I 31a	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear functions, and show intercepts.	F-IF7a Partial
Algebra I 36	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs.	F-BF3 Partial
Algebra I 8	Use the structure of an expression to identify ways to rewrite it. (linear)	A-SSE2

NMSI's Laying the Foundation lesson: Write the equation of the Line Review (lesson 1 day/ Additional practice 2 days) High School

Teacher Note: Students are asked to analyze the graph to identify the slope and y-intercept and write the equation of the line in standard form and slope intercept form. Questions #1h and #1i introduce students to shift changes for a linear function. Questions #2e and #2f ask students to write the equations of parallel and perpendicular lines. This is not a common core standard for Algebra I but for Geometry. This lesson assumes that students have already mastered the skill of writing equations in all of the different forms. Most of the 8th grade standards dealing with writing equations of lines have been designated for this course, so this may be more of an introduction. Teachers should have a big discussion about the situation in which each form is the best strategy for writing the equation of the line. Additional problems of writing the equation of a line given two points in point slope form, slope intercept form, and standard form should be taught using the textbook examples and practice. (Note: Common Core does not mention standard form.)

**** Use Unit 2 Checkpoint: #14 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 25	The graph of f is the graph of the equation $y = f(x)$(linear).	F-IF1 Partial
8th Grade 13	Interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line.	8-F3 Partial

NMSI's Laying the Foundation lesson: Piecewise Functions (1 day) High School

Teacher Note: This lesson is an excellent culminating lesson for linear functions. Students interpret a graph and a table, calculate the average rate of change, write the equation of a line from a graph, and write a verbal description of a graph. Students will use their knowledge of point-slope form and the interval notation to write piecewise functions.

**** Use Unit 2 Checkpoint: #15-#19 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 25	The graph of f is the graph of the equation $y = f(x)$(linear).	F-IF1 Partial
8th Grade 14	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of linear function in terms of the situation it models and in terms of its graph or a table of values.	8-F4
Algebra I 30	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.	F-IF6
Algebra I 31	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. b. Graph piecewise-defined functions.	F-IF7b
Algebra I 36	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$ and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. (linear)	F-BF3 Partial

**** Use Unit 2 Checkpoint: #20-#26 to review for a summative assessment.**

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 3: Systems of Linear Equations
12 days of instruction plus assessment time-2.5 weeks

NMSI's Laying the Foundation lesson: Literal equations- Reviewing and foreshadowing (2 days) High School

Teacher Note: The focus of this lesson is solving formulas***. Students may need a review of solving basic equations and need to practice their solving equation skills before completing this lesson.*** The textbook will have examples and practice to review the basic skills before moving into solving formulas. Emphasis should be placed on explaining what the solution means to the equation.

**** Use Unit 3 Checkpoint: #1 and #2 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 17	Solve linear equations in one variable, including equations with coefficients represented by letters.	A-REI3 Partial
Algebra I 16	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.	A-REI1
Algebra I 15	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. Example: Rearrange Ohm's law $V = IR$ to highlight resistance R.	A-CED4

NMSI's Laying the Foundation lesson: Linear Functions (1 day) -Middle Grades Mathematical Foundations

Teacher Note: This lesson is an introduction to the vocabulary associated with solving linear systems. Students will write two linear functions, create a table, graph the functions and compare functions to find the best deal.

**** Use Unit 3 Checkpoint: #3 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 12	Create equations and inequalities in one variable, and use them to solve problems. (linear)	A-CED1
8th Grade 14	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of linear function in terms of the situation it models and in terms of its graph or a table of values.	8-F4
Algebra I 20	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	A-REI6 Partial
Algebra I 46	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	S-ID7

Teacher Led Instruction- Intersection of linear functions substitution and elimination (3 days)

Teacher Note: These skills must be covered before "Painting the House". Textbooks cover these skills of solving systems of equation by substitution and elimination. Graphing Calculators can be used to check the point of intersection.

**** Use Unit 3 Checkpoint: #4 and #5 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th grade 10b	Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.	8-EE8b Partial
Algebra I 19	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.	A-REI5
Algebra I 20	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	A-REI6

NMSI's Laying the Foundation lesson: Painting the House (1 day)-High School

Teacher Note: In this real world scenario, students are given the dimensions of a house and tasked with finding the amount of paint needed. Students will find the area of each section of the house. Students will compare two different price functions to find the best deal. Students will write a function to model the situation, create a table of values, and graph the functions.

**** Use Unit 3 Checkpoint: #6-#12 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th Grade 10	a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersections of their graphs because points of intersection satisfy both equations simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. c. Solve real-world and mathematical problems leading to two linear equations in two variables. Example: Given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.	8-EE8a 8-EE8b Partial 8-EE8c
Algebra I 20	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	A-REI6

**NMSI's Laying the Foundation lesson: Solving Systems of Linear Equations (1.5 days) High School

Teacher Note: This lesson can be used with all students, but definitely used with PreAP students. In order to participate in this lesson, students should be able to solve a system of equations graphically and algebraically, write the equation of a line given two points, and to find the area of triangles, rectangles, and trapezoids. In this lesson, students are given the equations of lines. They must graph the lines, find their points of intersection, and find the area of the region inside the points of intersection. In order to find the length of the sides of the triangles, students must first find out where the two lines cross.

**** Use Unit 3 Checkpoint: #13-16 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th Grade 10	a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersections of their graphs because points of intersection satisfy both equations simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. c. Solve real-world and mathematical problems leading to two linear equations in two variables. Example: Given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.	8-EE8a 8-EE8b Partial 8-EE8c
Algebra I 20	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	A-REI6

Teacher Led Instruction– Absolute Value Equations (2 days)

Teacher Note: This is one of the concepts added in the 2013 revision, but absolute value was still not emphasized in COS. The Quality Core standard indicates that students can be tested on this. The Quality Core Algebra II Unit does a good job introducing solving simple absolute value equations. Most textbooks should also address this content,

AL COS	Common Core Standard	Common Core
Algebra I 23	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.*	A-REI11

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 4: Systems of Linear Inequalities
4 days of instruction plus assessment time-1 week

Teacher Led Instruction on solving and graphing simple inequalitities (2 days)

Teacher Note: The textbook has lessons and examples to teach the skill of solving and graphing multi-step linear inequalities. When teaching the inequality unit, be sure to include writing and solving a word problem that models an inequality. **After discussion and analysis of the Alabama Course of Study standards, the committee has come to the conclusion that a vertical team discussion about the inclusion or necessity of compound inequalities should be determined by each district.

**** Use Unit 4 Checkpoint: #1-#3 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 17	Solve linear inequalities in one variable.	A-REI3 Partial

NMSI's Laying the Foundation lesson: Maximizing Profit (2 days) High School

Teacher Note: This lesson is an excellent way to allow students to explore linear programming. It would be beneficial to practice the skill of graphing linear inequalities before exploring linear programming through word problems in this lesson. The textbook has lessons and examples on graphing linear inequalities.

**** Use Unit 4 Checkpoint: #4 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 12	Create equations and inequalities in one variable, and use them to solve problems. (linear)	A-CED1
Algebra I 14	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities and interpret solutions as viable or non-viable options in a modeling context. Example: Represent inequalities describing nutritional and cost constraints on combinations of different foods.	A-CED3
Algebra I 24	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.	A-REI12

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 5: Graphing and Analyzing Exponential Functions
6.5 days of instruction plus assessment time-1.5 weeks

NMSI's Laying the Foundation lesson: Exponential Function Exploration (2 days) High School

Teacher Note: This lesson includes a discovery activity that serves as a good introduction to exponential functions. In this lesson, students make a table, draw a graph, and discover the equation of an exponential function to model a situation. This lesson includes finding the area of a rectangle.

AL COS	Common Core Standard	Common Core
Algebra I 12	Create equations and inequalities in one variable, and use them to solve problems. (exponential)	A-CED1
Algebra I 13	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales (exponential).	A-CED2
Algebra I 31c	Graph exponential functions, showing intercepts and end behavior.	F-IF7e Partial
Algebra I 4	Choose and interpret the scale and the origin in graphs and data displays. (exponential)	N-Q1 Partial
Algebra I 26	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.	F-IF2
Algebra I 34a	a. Determine an explicit expression, a recursive process, or steps for calculation from a context.	F-BF 1a

NMSI's Laying the Foundation lesson: Exponential Growth (2 days) High School

Teacher Note: In this lesson, students analyze the growth rate of a plant and of a rabbit population. Students analyze a pattern to write an exponential function to represent a modeling situation and use the table and equation to make prediction about population growth.

**** Use Unit 5 Checkpoint: #1 and #2 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 12	Create equations and inequalities in one variable, and use them to solve problems. (exponential)	A-CED1
Algebra I 34a	a. Determine an explicit expression, a recursive process, or steps for calculation from a context.	F-BF 1a

How do you start, How do you change? (1.5 days) (Non NMSI's Laying the Foundation lesson by Kitty Morgan)

Teacher Note: This is an excellent lesson to help students understand how to write an exponential function. This lesson provides students several different situations to practice creating and analyzing exponential growth and decay functions. This lesson draws upon students' work and conclusions from the two exponential function lessons listed above. A discussion about decimal accuracy due to use of money in #1-4 might need to occur.

**** Use Unit 5 Checkpoint: #3 and #4 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 7b	b. Interpret complicated expressions by viewing one or more of their parts as a single entity. Example: Interpret $P(1+r)n$ as the product of P and a factor not depending on P.	A-SSE1b
Algebra I 32b	b. Use the properties of exponents to interpret expressions for exponential functions. Example: Identify percent rate of change in functions such as $y = (1.02)^t$, $y = (.97)^t$, $y = (1.01)^{12t}$, and $y = (1.02)^{\frac{t}{10}}$, and classify them as representing exponential growth and decay.	F-IF8b
Algebra I 8	Use the structure of an expression to identify ways to rewrite it. (exponential)	A-SSE2
Algebra I 28	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.*(Exponential)	F-IF4 Partial
Algebra I 26	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context (exponential).	F-IF2
Algebra I 25	The graph of f is the graph of the equation $y = f(x)$. (exponential)	F-IF1
Algebra I 6	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	N-Q3
Algebra I 22	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). (exponential)	A-REI10
Algebra I 31c	Graph exponential functions, showing intercepts and end behavior.	F-IF7e Partial

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 6: Arithmetic and Geometric Sequences
6 days of instruction plus assessment time-1.5 weeks

Unit Note: This unit work should stress the connection of arithmetic sequences to linear functions and geometric sequences to exponential functions.

NMSI's Laying the Foundation lesson: Writing Equations Using Sequences (2 days) High School

Teacher Note: This lesson is an excellent introduction to the vocabulary associated with sequences. Problems 1-3 address arithmetic sequences. Problems 4-8 address sequences that are not linear and may be used as additional problems as an extra challenge to students.

**** Use Unit 4 Checkpoint: #4-#5 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 38	Construct linear and exponential functions, including arithmetic and sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	F-LE2 Partial
Algebra I 35	Write arithmetic sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	F-BF2 Partial

NMSI's Laying the Foundation lesson: Arithmetic Sequences (2 days) Middle Grades

Teacher Note: This lesson builds on the previous lesson and introduces students to the explicit formula for an arithmetic sequence.

**** Use Unit 6 Checkpoint: #1-#3 after completing this lesson.**

AL COS	Common Core Standard *)*	Common Core
Algebra I 38	Construct linear functions, including arithmetic sequences, given two input-output pairs (include reading these from a table).	F-LE2 Partial
Algebra I 35	Write arithmetic sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	F-BF2 Partial
Algebra I 25	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.	F-IF1 Partial

NMSI's Laying the Foundation lesson: Limits-A Physical Approach (2 days) Middle Grades

Teacher Notes: This activity was chosen because a student must take previous output and manipulate it to get the next output in the table to show the recursive nature of the series. The student must then define the pattern with a formula in the last step. The example in Algebra I #26 is an example of a recursive sequence and does not indicate that you must discuss the Fibonacci sequence at this point.

AL COS	Common Core Standard	Common Core
Algebra I 27	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. Example: The Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.	F-IF3
Algebra I 38	Construct exponential functions and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	F-LE2 Partial
Algebra I 35	Write geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	F-BF2 Partial
Algebra I 25	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.	F-IF1 Partial

Teacher note: Additional opportunities to practice arithmetic and geometric sequence skills by incorporating textbook or other resources are strongly suggested to help students master these concepts. There are some excellent resources in the Algebra II Quality Core Unit 1.

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Semester Exam Review for Algebra I

NMSI's Laying the Foundation lesson: Reading the Graph (1 day) High School

Teacher Note: This lesson provides a culminating activity for linear functions where students compare, analyze, and interpret two graphs using functional notation, average rate of change, and a verbal description.

AL COS	Common Core Standard	Common Core
8th Grade 12	Compare properties of two functions, each represented in a different way (graphically).	8-F2 Partial

NMSI's Laying the Foundation lesson: Putting the Pieces Together (1 day) High School

Teacher Note: This lesson is an excellent culminating lesson for linear functions. Students interpret several graphs and a table, calculate the average rate of change, write the equation of a line from a graph, and write a verbal description of a graph.

AL COS	Common Core Standard	Common Core
Algebra I 25	The graph of f is the graph of the equation $y = f(x)$(linear).	F-IF1 Partial
8th Grade 14	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of linear function in terms of the situation it models and in terms of its graph or a table of values.	8-F4
Algebra I 30	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.	F-IF6
Algebra I 31	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. b. Graph piecewise-defined functions.	F-IF7b
Algebra I 36	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$ and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. (linear)	F-BF3 Partial

Let's Make a Deal

(2 days with no calculator knowledge/1 day with calculator knowledge)
(Non NMSI's Laying the Foundation lesson by Kitty Morgan)

Teacher Notes: This lesson is a culminating activity that allows students to compare constant growth with constant percentage growth. This lesson was designed to help students analyze and compare the similarities and differences between linear and exponential functions. Given two modeling situations, students will write an equation, create a table, and analyze the graph to determine which situation represents the better deal. Students will need graphing calculators for this lesson.

AL COS	Common Core Standard	Common Core
Algebra I 37	Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.	F-LE1 F-LE1a F-LE1b F-LE1c
Algebra I 23	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~~. .* (The crossed out functions will be addressed in a future course)	A-REI11
Algebra I 39	Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratic ally, or (more generally) as a polynomial function.	F-LE3 Partial
Algebra I 7a	Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression such as terms, factors, and coefficients.	A-SSE1a
Algebra I 29	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	F-IF5

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 7: Descriptive Statistics and Conditional Probability
10 days of instructional days plus assessment time-2.5 weeks

NMSI's Laying the Foundation lesson: Fitting a Line to Data (2 days) High School

Teacher Notes: This lesson is a non-calculator activity that introduces the line of best fit, using a line to make a prediction, and using the residual to determine how well the line fits the scatterplots data.

**** Use Unit 7 Checkpoint: #1-4 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th Grade 25	Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	8-SP1 Partial
8th Grade 26	Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.	8-SP2
8th Grade 27	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.	8-SP3
Algebra I 45	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Emphasize linear and exponential models.* b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association.	S-ID6 S-ID6a S-ID6b S-ID6c
Algebra I 46	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	S-ID7

The following LTF lessons have been moved to the middle grades. If these lessons have not been previously used, students may need to be introduced to them before going through the Algebra I lessons.

- Measures of Central Tendencies- In #3 of this lesson, make large pieces of paper with the family ages on them so that students may represent the different characters in the story. Let the students physically move in and out of the line up as the different scenarios change, so that they can be part of the data and better visualize how the mean and median change as the data changes. The Quality Core standard *G.1.a. Identify the effect on mean, median, mode, and range when a set of data is changed* is covered well in this lesson and is not covered as well in the Algebra I suggested lessons. Suggestions for checkpoint problems that cover this are below.
- Histograms-This lesson guides students to define data as categorical or quantitative and distinguishes between what type of graph is used to graph each type of data.
- Box and Whiskers- This lesson introduces students to the five-number summary and to vocabulary about data including the outliers, gaps and clusters. The lesson allows students to use graphing calculators and compare two box plots.

**** Use Unit 7 Checkpoint: #5-27 to assess the skills in the lessons above / 11,12,14,16,18,19 deal directly with Quality Core Standard G.1.a**

NMSI's Laying the Foundation lesson: Use Dot plots(line plots) to Determine Mean, Median, Mode and Range (1 day) High School

Teacher Note: In this lesson students will plot data and explore the data looking at dot plots.
**** Use Unit 7 Checkpoint: #28-29 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 41	Represent data with plots on the real number line (dot plots).	S-ID1

NMSI's Laying the Foundation lesson: Analyzing Mean, Median, Mode and Range (2 days)

Teacher Note: Students will analyze mean, median, mode and range to determine if results are favorable or unfavorable in given situations. This lesson is a great summative activity to put together all of the vocabulary and analyzing data.

AL COS	Common Core Standard	Common Core
Algebra I 42	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.	S-ID2
Algebra I 43	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	S-ID3

NMSI's Laying the Foundation lesson: Describing Distribution: Standard Deviation (2 days)

Teacher Note: The lesson begins with an explanation of computing standard deviation by hand. Students build conceptual understanding of standard deviation as a measurement of variability. Students should be comfortable with measures of center and shapes of distributions.

AL COS	Common Core Standard	Common Core
41	Represent data with plots on the real number line (dot plots, histograms, and box plots).	S-ID1
42	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.	S-ID2
43	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	S-ID3

NMSI's Laying the Foundation lesson: Movie Probability (1day) Middle Grades

Teacher Note: This lesson introduces the students to a two-way frequency table, but does not adequately cover the association that #44 and 8th grade #28 suggest. The vocabulary in the following standards may be new to teachers and students and the following website will help with the new vocabulary and give an example of a two-way frequency table that does discuss how the data in the table can be interpreted and the association of the data can be discussed. http://stattrek.com/statistics/two-way-table.aspx

**** Use Unit 7 Checkpoint: 30#-39# after completing this lesson.**

AL COS	Common Core Standard	Common Core
Moved to Algebra II	Describe events as subsets of a sample space (the set of outcomes), using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (—or,‖ —and,‖ —not‖).	S-CP1
Algebra I 44	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).	S-ID5 Partial
8th Grade 28	Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table.	8-SP4 Partial

NMSI's Laying the Foundation lesson: Does Gender Make a Difference? (1day) Middle Grades

Teacher Note: This lesson uses a two-way frequency table data to help create side-by-side and segmented bar graphs and interpret the results in the context of the situation

AL COS	Common Core Standard	Common Core
Algebra I 44	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.	S-ID5
8th Grade 28	Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.	8-SP4

Teacher Led Instruction- Independence in Probability (1 day)

Teacher Note: The idea of two events being independent is covered in depth in Algebra II. #36 of the checkpoints could be used to introduce the idea of two things being independent. To find the probability involving two events that do not have anything in common, you simply multiply their individual probabilities. The textbook should also provide examples and practice of the following standard. The following website provides additional examples http://www.mathgoodies.com/lessons/vol6/independent_events.html

**** Use Unit 7 Checkpoint: #36 to introduce Independence.**

AL COS	Common Core Standard	Common Core
Algebra I 47	Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.	S-CP2

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 8: Pythagorean Theorem, Radicals and Rational Exponents
6 days of instruction plus assessment time-1.5 weeks

Teacher Led Instruction (3 days)

Teacher Note: Solving quadratic equations by inspection is a great introduction to the Pythagorean Theorem. You may want to include instruction on simplifying radicals in this unit. **After discussion and analysis of the Alabama Course of Study standards, the committee has come to the conclusion that a vertical team discussion about the inclusion or necessity of simplifying and performing operations with radicals should be determined by each district. The Alabama Course of Study does not explicitly state simplifying radicals as a standard, but Quality Core has specific content standards for this.

AL COS	Common Core Standard	Common Core
Algebra I 18b	Solve quadratic equations by inspection (e.g., for $x^2 = 49$) and taking square roots.	A-REI4b Partial

Teacher Led Instruction- Pythagorean Theorem (2 days)

Teacher Note: The following resource is an excellent model of the proof of the Pythagorean Theorem. This activity gives a full explanation of how to present the material with student activity pages and teacher notes. This lesson can be found at http://www.map.mathshell.org/materials/lessons.php . There is a power point and black line masters that well help teach this. In order to cover the entire standard, the converse of the theorem must be covered by the teacher through other resources.

**** Use Unit 8 Checkpoint: #1 and 2 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th Grade 21	Explain a proof of the Pythagorean Theorem and its converse.	8-G6
8th Grade 23	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	8-G8

NMSI's Laying the Foundation lesson: Pythagorean Theorem Applications Problems #1-4
(1 day)- High School

Teacher Note: Problems #1-4 in this lesson model the Pythagorean Theorem in real-life situations. Problems #5-10 have application problems that include similar triangles; finding the area of a trapezoid, circle, or rhombus; and finding the volume and surface area of a pyramid and could be used for challenging students.

**** Use Unit 8 Checkpoint: #2 after completing this lesson.**

AL COS	Common Core Standard	Common Core
8th Grade 22	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	8-G7

**NMSI's Laying the Foundation lesson: Brenna Rescues Andrew

Teacher Note: This lesson can be used with all students, but definitely used with PreAP students. You can use this instead of or in addition to Pythagorean Theorem Application Problems #1-4. This lesson provides extra Pythagorean modeling problems. Problems #1abc, #2abc, #3abc, #4abc address these standards directly. Problems #1def, #2def, #3def, #4def all require dimensional analysis. This may be a good place to incorporate and teach dimensional analysis.

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 9: Polynomials
8 days of instruction plus assessment time-2 weeks

Teacher Note: It is easy to incorporate the connection to radicals and exponents at this point in the curriculum. Students have just seen radicals when solving Pythagorean theorem problems. They will now be exploring the rules of exponents when they study monomials. The textbook has lessons to cover these skills.

Teacher Led Instruction (8 days)

Teacher Note: In order to cover the standards below, the rules of exponents should first be explored with monomials. The textbook provides examples and practice of multiplying like bases $\left(2x^3\right)\left(5x^4\right)$ and power to a power $\left(2x^3\right)^5$. **After discussion and analysis of the Alabama Course of Study standards, the committee has come to the conclusion that a vertical team discussion about the inclusion or necessity of operations with negative exponents should be determined by each district. Negative exponents are mentioned in #3 of 7th Grade Course of Study, but only for numerical expressions.

Students have been exposed to square roots and cube roots in 7th Grade COS #4.

In Standard #2, students are gaining the understanding that $\sqrt[3]{125} = (125)^{\frac{1}{3}}$ and that the answer to both is 5.

In Standard #1, the student is synthesizing the rules of exponents for monomials with standard #2.

AL COS	Common Core Standard	Common Core
Algebra I 2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.	N-RN2
Algebra I 1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. Example: We define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.	N-RN1

**** Use Unit 9 Checkpoint: #1-2 after completing this lesson.**

Teacher Led Instruction

Teacher note: The textbook provides examples and practice of the following standards.

AL COS	Common Core Standard	Common Core
Algebra I 10	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.	A-APR1

**** Use Unit 9 Checkpoint: #3-6 after completing this lesson.**

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 10: Graphing Analyzing Quadratic Functions
6 instructional days plus assessment time-1.5 Weeks

NMSI's Laying the Foundation lesson: Investigation- Graphing Quadratic Functions (2 days) High School

Teacher Note: This lesson allows the student to use a graphing calculator to discover changes in quadratic graphs. It also uses a few linear problems to try and pull in the idea of steepness in linear versus quadratic graphs.

**** Use Unit 10 Checkpoint: #1 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 9c	c. Determine a quadratic equation when given its graph or roots.	Alabama standard
Algebra I 13	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales(Quadratic).	A-CED2
Algebra I 28	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 and relative maximums.* (Quadratics)	F-IF4 Partial
Algebra I 36	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, 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. (linear and quadratic)	F-BF3 Partial

Teacher Note: You can incorporate the following standard into this NMSI's Laying the Foundation lesson. Use Problem #1 to teach students to calculate the average rate of change from a table of values over a specified interval. Use Problem #2 to teach students to estimate the average rate of change from the graph.

Algebra I 30	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. (quadratic)	F-IF6

NMSI's Laying the Foundation lesson: Graphing Quadratic Functions #1 (2 days) High School

Teacher Note: Only use # 1 from this lesson at this point; Example 2 is included in a later unit. #1 is an introduction of what type of situation models a quadratic function and the domain and range, intercepts, and vertex of quadratics are introduced in a real-world model.

AL COS	Common Core Standard *Quality Core Identifier. Quality Core Standard(s)*	Common Core
Algebra I 28	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,*	F-IF4

	decreasing, positive, or negative; relative maximums and minimums; symmetries and end behavior. (Quadratic)	
Algebra I 31a	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph quadratic functions, and show intercepts, maxima, and minima.	F-IF7a

****NMSI's Laying the Foundation lesson: Quadratic Optimization (2 days) High School**

Teacher Note: This lesson can be used with all students, but definitely used with PreAP students. In addition to addressing quadratic models, this lesson includes perimeter and area of a rectangle, which addresses ARMT measurement standards. Students will use system of equations to solve for the length of a rectangle, and substitute the length into the area formula. The resulting formula will be a factored quadratic that must be graphed (a graphing utility could be used) and then the maximum area is obtained. This lesson is an excellent motivation for students to make the connection between the roots of the graph and the equation of the quadratic.

**** Use Unit 4 Checkpoint: #2-4,8 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 13	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (quadratic)	A-CED2
Algebra I 28	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 and end behavior.*(Quadratic)	F-IF4
Algebra I 9c	c. Determine a quadratic equation when given its graph or roots.	Alabama standard

**** Use Unit 10 Checkpoint: #5-7 to review for the summative assessment.**

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 11: Factoring and the Quadratic Formula
21 days of instruction plus assessment time-5.5 weeks

Teacher Led Instruction (16 days)

Teacher Note: The following standards represent skills and should be addressed in your textbook. After the students have mastered the following skills, the skills will be reinforced in LTF Lessons. Algebra I #3 is included here because it can be incorporated when discussing the different types of solutions given from the quadratic formula.

**** Use Unit 11 Checkpoint: #1 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 8	Use the structure of an expression to identify ways to rewrite it. 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 $(x^2 - y^2)(x^2 + y^2)$.	A-SSE2
Algebra I 9a	a. Factor a quadratic expression to reveal the zeros of the function it defines.	A-SSE3a
Algebra I 18	Solve quadratic equations in one variable. a. 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. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square and 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* ± *bi* for real numbers *a* and *b*.~~ (The crossed out part is addressed in Algebra II.	A-REI4
Algebra I 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.	N-RN3
Algebra I 32a	Use the process of 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.	F-IF8a Partial
Algebra I 9b	Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.	A-SSE3b

NMSI's Laying the Foundation lesson: Another way to look at factoring (2 days) High School

Teacher Note: This lesson is a great summary activity to help students look at factoring in a different way. In order to participate in this lesson, students should already know how to factor and should be proficient in using a graphing calculator.

AL COS	Common Core Standard	Common Core
Algebra I 7	Interpret expressions that represent a quantity in terms of its context.* a. Interpret parts of an expression such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a	A-SSE1a

	single entity. (quadratic)	A-SSE1b
Algebra I 9a	a. Factor a quadratic expression to reveal the zeros of the function it defines.(quadratic)	A-SSE3a
Algebra I 18b	Solve quadratic equations by factoring.	A-REI4b Partial

NMSI's Laying the Foundation lesson: Graphing Quadratic Functions- (#2-4) (3 days) -High School

Teacher Note: The quadratic equations in this activity can be solved by factoring and additional opportunities to factor and interpret quadratic graphs without the use of graphing calculators. A discussion of axis of symmetry would be appropriate for this lesson.

**** Use Unit 11 Checkpoint: #2 after completing this lesson.**

AL COS	Common Core Standard	Common Core
Algebra I 12	Create equations and inequalities in one variable, and use them to solve problems. (quadratic)	A-CED1
Algebra I 29	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	F-IF5
Algebra I 32a	Use the process of factoring in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	F-IF8a Partial
Algebra I 34	Write a function that describes a relationship between two quantities. * (quadratic)	F-BF1
Algebra I 30	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.	F-IF6
Algebra I 45a	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.* (quadratic)	S-ID6a Partial
Algebra I 4	Use units as a way to understand problems and to guide the solution of multistep problems.	N-Q1 Partial
Algebra 1 31 a	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* a. Graph quadratic functions, and show intercepts, maxima, and minima.	F-IF7a Partial

A National Math and Science Initiative Program
A+ COLLEGE READY
A Division of the A+ Education Partnership

Unit 12: Rational Functions
6 days of instruction plus assessment time-1.5 weeks

Teacher Led Instruction (6 days)

Teacher Note: This topic should be covered well in traditional textbooks.

AL COS	Common Core Standard	Common Core
Algebra1 12	(+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. (Added from original Algebra II COS)	A-APR7
Algebra I 8	Use the structure of an expression to identify ways to rewrite it. (Added from original Algebra II COS)	A-SSE2

Unit 13: 2nd Semester Exam Review

Teacher Note: In this review, students will synthesize their knowledge of graphs and functions. Students will revisit some function types studied earlier in the year as well as explore new functions. In order to cover the increased rigor and content of the 2010 Alabama Course of Study, several LTF lessons from High Schools are recommended. You may need to pick the lessons that students need extra practice and will need to spend some time with the rest of the semester content. If these lessons are not used, they may be used in the Algebra II course.

NMSI's Laying the Foundation lesson: Adaptation of Algebra I 2007 EOC Free Response (2 days)-High School

Teacher Note: This lesson provides a summary of many concepts taught throughout the year. Students will sketch a graph from a verbal description, write the equation of linear and quadratic equations, examine intervals of increase and decrease, as well as incorporate the domain and range of functions. They will also be introduced to piecewise functions.

AL COS	Common Core Standard	Common Core
Algebra I 28	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 or decreasing .*	F-IF4 Partial
Algebra I 31b	Graph piecewise-defined functions.	F-IF7b Partial
Algebra I 13	Create equations in two or more variables to represent relationships between quantities. Graph equations on coordinate axes with labels and scales to represent relationships between quantities.	A-CED2
Algebra I 29	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	F-IF5

**NMSI's Laying the Foundation lesson: Transformations of Functions Exploration (2 days) -High School

Teacher Note: This lesson can be used with all students, but definitely used with PreAP students.In this lesson, students explore families of functions to analyze the effects of horizontal and vertical shifting of graphs as well as the effect of scalar multiplication. Students explore quadratic functions, absolute value, cubic functions, and square root functions. At the end of this lesson, there is an activity sheet where students summarize the parent function and its domain, range, and graph. Algebra I students are expected to master all of the functions on the first page and only the exponential growth function from the second page. (The other functions on the second page will be explored and mastered in Algebra II.)

AL COS	Common Core Standard	Common Core
Algebra I 31b	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. b. Graph absolute value functions.	F-IF7b Partial
Algebra I 36	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. (quadratic,	F-BF3 Partial

	and absolute value)	

**NMSI's Laying the Foundation lesson: Even/Odd Functions (2 days) High School

Teacher Note: This lesson can be used with all students, but definitely used with PreAP students.This lesson builds upon students' work from the "Transformations of Functions Exploration" lesson, starting with an analysis of the answer sheet from that lesson where the students compare each family of functions. Students analyze and discuss in depth the defining characteristics of an even function (function symmetric with respect to the y axis) and an odd function (function symmetric with respect to the origin). Students graph several new functions and analyze the characteristics of the functions, including domain/range and even/odd functions. Students use the graphing calculator to support their work in this lesson.

AL COS	Common Core Standard	Common Core
Algebra I 31b	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. B Graph absolute value functions.	F-IF7b
Algebra I 36	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. (linear, quadratic, and absolute value)	F-BF3

Teacher Directed Instruction with some other materials (2 days)

Teacher Note: Since students have spent several days exploring a variety of function types, this would be a good time to discuss nonlinear systems of equations. The textbook should provide examples and practice with the skill of solving a system of equations with a linear equation and a quadratic equation.

AL COS	Common Core Standard	Common Core
Algebra I 21	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. Example: Find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.	A-REI7

Teacher Note: The textbook provides examples to compare different types, different representation, and different models of linear, exponential, and quadratic functions. This standard provides a summary and comparison of the different functions students have learned throughout the year and, more specifically, within this last unit. There is a great problem that does this in the PARCC assessments.

AL COS	Common Core Standard *Quality Core Identifier. Quality Core Standard(s)*	Common Core
Algebra I 33	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *(compare linear, exponential, and quadratic)* Example: Given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.	F-IF9

**Additional NMSI's Laying the Foundation lesson: Maximums, Minimums, and Intervals-Oh My!-High School

Teacher Note: This lesson can be used with all students, but definitely used with PreAP students. This lesson provides extra practice problems to reiterate standards already covered in previous lessons. Students analyze key characteristics of a linear graph and a quadratic graph. This lesson pulls together many different standards and provides a good review of the year. Some of the questions may be a bit challenging for students.

AL COS	Common Core Standard	Common Core
Algebra I 31a	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph quadratic functions, and show intercepts, maxima, and minima.	F-IF7A
Algebra I 28	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 and end behavior.*	F-IF4
Algebra I 30	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.	F-IF6

**Additional NMSI's Laying the Foundation lesson: Adaptation of AP Calculus 1997 AB-2 -High School

Teacher Note: This lesson can be used with all students, but definitely used with PreAP students. This lesson provides extra practice problems to reiterate standards already covered in previous lessons. Students analyze key characteristics of a linear graph and a quadratic graph. This lesson pulls together many different standards and provides a good review of the year. Some of the questions may be a bit challenging for students.

AL COS	Common Core Standard	Common Core
Algebra I 31a	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph quadratic functions, and show intercepts, maxima, and minima.	F-IF7A
Algebra I 28	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 and end behavior.*	F-IF4
Algebra I 30	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.	F-IF6