

ALGEBRA 1 Intervention Guide

Designed to assist teachers with at-risk students in Algebra I, IA and/or IB.

Part I: Alabama Course of Study for Mathematics; pages 2-5

Part II: Alabama High School Graduation Exam Objectives (AHSGE); pages 6-7

Part III: Intervention Guide; pages 8-18

*See PowerPoint with specific instructions



Part I

Algebra I Course of Study (May 2009)

The Algebra I course provides students with mathematical experiences that are useful in everyday life. The reasoning and problem-solving skills used in Algebra I may be applied to life situations beyond the classroom. Algebra I is also the cornerstone of high school mathematics. Every course beyond Algebra I requires the knowledge of these content standards. Therefore, it is of utmost importance that each standard be mastered. Algebra I builds on foundational content learned by students in Grades K-8 by expanding mathematics understanding to provide students with a strong mathematics education.

Algebra I is the basis for the majority of the mathematics content included on the *Alabama High School Graduation Exam (AHSGE)*. Therefore, it is one of the courses required for all students. School systems may offer Algebra I and Algebra IA and Algebra IB. Content standards 1, 2, 3, 4, 12, 13, 14, 15, and linear equations and inequalities from content standard 7 must be taught in the Algebra IA course. Content standards 5, 6, 8, 9, 10, 11, and the remainder of content standard 7 must be taught in the Algebra IB course. Systems offering Algebra I in the eighth grade have the responsibility of ensuring that all Algebra I course content standards are included in instruction.

Number and Operations

Students will:

1. Simplify numerical expressions, including those involving square roots, radical form, and decimal approximations using properties of real numbers and order of operations.

Example: Express $\sqrt{27} + \sqrt{75}$ in simplified form. Answer: $8\sqrt{3}$.

- Applying laws of exponents to simplify expressions, including those containing zero and negative integral exponents

Examples: Simplify $\frac{x^3y^4}{x^3y^{-2}}$. Answer: y^6 .

Multiply 2.4×10^5 by 3.1×10^3 . Answer: 7.44×10^8 .

Divide $\frac{2.4 \times 10^5}{1.2 \times 10^7}$. Answer: 2×10^{-2} .

Algebra

2. Analyze linear functions from their equations for their characteristics, including slopes and intercepts.
Example: Evaluate $f(0)$ for $f(x) = 3x + 4$. Answer: $f(0) = 4$.
 - Determining the slope of a line from its equation or by applying the slope formula
 - Determining equations of linear functions given two points, a point and the slope, tables of values, graphs, or ordered pairs
 - Graphing two-variable linear equations and inequalities on the Cartesian plane
3. Determine properties of a relation, including domain, range, and whether it is a function, when given graphs, tables of values, mappings, or sets of ordered pairs.
 - Finding the range of a function when given its domain
Example: Find the range of $f(x) = -x^2 + 2x - 3$ when given the domain $\{-4, -2, 0, 2, 4\}$. Answer: $\{-27, -11, -3\}$.
4. Construct graphs of common relations, including $x = \text{constant}$, $y = \text{constant}$, $\sqrt{\quad}$, and $|\quad|$.
 - Identifying applications modeled by common relations, including $x = \text{constant}$, $y = \text{constant}$, $y = x$, $y = \sqrt{x}$, $y = x^2$, and $y = |x|$
5. Perform operations of addition, subtraction, and multiplication on polynomial expressions.
 - Dividing a polynomial by a monomial
 - Evaluating polynomial functions
6. Use GCF, difference of squares, perfect square trinomials, and grouping to factor binomials, trinomials, and other polynomials.
7. Solve multistep equations and inequalities, including linear, radical, absolute value, and literal equations.
Example: solving for x in problems, including $\sqrt{x} - 4 = 0$, $\sqrt{x-4} < 2$, $|x| = 6$,
 $|x+3| \geq 10$, $y = mx + b$, and $ax + by + c = 0$
 - Writing the solution of an equation or inequality in set notation
Example: Find the solution of $|x+3| \geq 10$. Answer: $\{x \mid x \geq 7 \text{ or } x \leq -13\}$.
 - Formulating the design of application-based problems by developing and solving equations and inequalities, including those involving direct and inverse variation, distance, uniform motion, and mixture

8. Solve systems of linear equations and inequalities in two variables graphically and algebraically.
 - Designing models of application-based problems by developing and solving systems of linear equations and inequalities
9. Solve quadratic equations using the zero product property.
 - Determining approximate solutions of quadratic equations graphically and numerically
 - Solving quadratic equations using the quadratic formula and completing the square

Geometry

10. Calculate length, midpoint, and slope of a line segment when given coordinates of its endpoints on the Cartesian plane.
 - Deriving distance, midpoint, and slope formulas for line segments
 - Utilizing the Pythagorean Theorem to solve application-based problems

Measurement

11. Solve problems algebraically involving area and perimeter of a polygon, area and circumference of a circle, and volume and surface area of right circular cylinders or right rectangular prisms.
 - Applying area and volume formulas to solve application-based problems

Example: *Find the radius of a circle with an area of 75 square inches.*

$$\text{Answer: } \sqrt{\frac{75}{\pi}} \text{ or } 5\sqrt{\frac{3}{\pi}} .$$

Continued...

Data Analysis and Probability

12. Compare various methods of data reporting, including scatterplots, stem-and-leaf plots, histograms, box-and-whisker plots, and line graphs, to make inferences or predictions.
 - Determining effects of linear transformations of data
Example: concluding that if the teacher adds 5 points to each student's grade on an algebra test with mean score of 78, the new mean score will be 83
 - Determining effects of outliers
 - Critiquing the design of a survey

13. Identify characteristics of a data set, including numerical or categorical and univariate or bivariate.
Example: conducting a survey of 100 students to determine whether boys and girls prefer to watch the same genres of movies to get a bivariate, categorical data set
14. Use a scatterplot and its line of best fit or a specific line graph to determine the correlation existing between two sets of data, including positive, negative, or no correlation.
15. Calculate probabilities given data in lists or graphs.
 - Comparing theoretical and experimental probabilities for data in lists or graphs

Part II

Algebra High School Graduation Objectives

Standard I: The student will perform basic operations on algebraic expressions.

Objectives:

1. Apply order of operations.
2. Add and subtract polynomials.
3. Multiply polynomials.
4. Factor polynomials.

Standard II: The student will solve equations and inequalities.

Objectives:

1. Solve multi-step equations of first degree.
2. Solve quadratic equations that are factorable.
3. Solve systems of two linear equations.
4. Solve multi-step inequalities of first degree.

Standard III: The student will apply concepts based on functions.

Objectives:

1. Identify functions.
2. Find the range of functions when given domain.

Standard IV: The student will apply formulas.

Objectives:

1. Find the perimeter, circumference, area, or volume of geometric figures.
2. Find the distance, midpoint, or slope of line segments when given two points.

Standard V: The student will apply graphing techniques.

Objectives:

1. Graph or identify graphs of linear equations.
2. Graph lines given certain conditions.
3. Determine solution sets of inequalities.
4. Identify graphs of common relations.

Standard VI: The student will represent problem situations.

Objective:

1. Translate verbal or symbolic information into algebraic expressions; or identify equations or inequalities that represent graphs or problem situations.

Standard VII: The student will solve problems involving a variety of algebraic & geometric concepts.

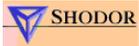
Objectives:

1. Apply properties of angles and relationships between angles.
2. Apply Pythagorean Theorem.
3. Apply properties of similar polygons.
4. Apply properties of plane and solid geometric figures.
5. Determine measures of central tendency.
6. Determine probabilities.
7. Solve problems involving direct variation.
8. Solve problems involving algebraic concepts.

Part III: Algebra I Intervention Document

This document takes the Alabama Course of Study for Algebra I and offers activities and links for each concept. The introductory PowerPoint offers additional information and samples of some of the work. Folders contain some rudimentary podcast idea's and PowerPoint lessons mentioned below.

Legend:

Symbol	Meaning
	<p><u>Quick Activity</u>: As a review or in preparation for the following day. These activities can be done when a lesson wraps up earlier than expected.</p>
	<p><u>ALEX Lesson Plan Keywords and Link</u>: This symbol indicates the presence of an ALEX lesson plan. If the link does not work, use the key words. Lessons are always being added to ALEX, so check the site out often!</p>
	<p><u>AMSTI school activity</u>: Even if your school is not an official AMSTI school there are wonderful activities promoted at their workshops to supplement existing lessons! If you have questions consider contacting one of the many AMSTI trained teachers throughout the state.</p>
	<p><u>Activity Link to a specific online activity from Shodor.org</u>: Shodor also offers lesson plans online for teachers and parents to assist students with conceptual understanding; grades K-12. Check them out at http://www.shodor.org/</p>
	<p><u>Link to an online activity from NCTM's ILLUMINATIONS</u>: the National Council for Teachers of Mathematics offer applets on their Illuminations website – these applets can help a student to visualize the mathematics being learned in the classroom. Consider 'Figure This' for Problems of the week @ http://www.figurethis.org/challenges/challenge_index.htm Solutions are provided.</p>
	<p><u>Hands-on Activity</u>: An idea for a project, extra credit, homework, or a simple lesson extension is given. The teacher can develop the lesson as needed and develop his/her own grading rubric if needed. If the activity is located under the 'for the teacher' column then pre-planning is required.</p>

For the Teacher
Lesson Plans and AMSTI Material

For the Student
Links and Teacher-led Activities

Course of Study Item #1

Simplify numerical expressions, including those involving square roots, radical form, and decimal approximations using properties of real numbers and order of operations.

For help with basic number operations:



PEMDAS Foldable (flap lifts to see the associated word and symbol)



Visualize exponents. A picture is included in the corresponding PowerPoint. Have students make squares on paper and glue rice for exponents. Ex: 2^1 , 2^2 , 2^3 , 2^4 ...etc... they will not be



able to get far. for a faster look, just do pencil tick marks, or draw stars in each box. The student will quickly get the idea of exponential growth.

For help with basic number operations:



[Order of Operations Four \(like connect four\)](#)



[Order of Operations Quiz](#)



[Primary Krypto](#) A game where students are given a target number and asked to enter operators (+, -, etc...) to make true statements. As an extension, have students write their results as an actual equation using parenthesis (this applet uses stages).



Create an equation using all 5 orders of operations which equals a specific number (have students share various results).



Around the world with Flashcards (multiplication facts review)



Quick Word Lists (Ex: List words that indicate "+")



[FractionSorter](#)



[Fraction Sorter](#) visualize fractions, decimals and percents.

	 FractionQuiz  Free Ride Use bicycle components to understand numeric fractions
<p style="text-align: center;"><u>For help with exponents:</u></p>   All About Alice!	<p style="text-align: center;"><u>For help with exponents:</u></p>  Have students write as many of their exponent rules down as they can recall in 5 minutes (in Algebraic Form). Ex: $(a^n)(a^m) = a^{n+m}$. These formulas are not included on their AHSGE formula sheet (and no formula sheet is provided for the ACT/SAT). Memorizing formula's will benefit them now and later (in Algebra II when the exponents become fractions).
<p>Course of Study Item #2 Analyze linear functions from their equations for their characteristics, including slopes and intercepts. Example: Evaluate $f(0)$ for $f(x) = 3x + 4$. Answer: $f(0) = 4$.</p>	
<p style="text-align: center;"><u>For help with the concept of functions:</u></p>  Have students create input/output charts (keeping the function a secret) and let the other students guess the function or even a missing part of the input/output chart. Try some without numbers! A PowerPoint is Provided for this activity,	<p style="text-align: center;"><u>For help with the concept of functions:</u></p>  Positive Linear Function Machine  Have students create input/output charts (keeping the function a secret) and let the other students guess the function (see AMSTI activity).
<p style="text-align: center;"><u>For help with plotting basic points:</u></p>   Have students create their own plot-dot. Cross-curriculum art and math. If they can generate a plot-dot, they can plot a point. Sample art provided in the PowerPoint and folder.	<p style="text-align: center;"><u>For help with plotting basic points:</u></p>  General Coordinates Game (ID)  Maze Game - mine field with coordinates  Ordered Simple Plot (turns ordered pairs into graphs)

For help with slope basics:



Find the slopes of stairs/ramps throughout the school (tip – go to the football stadium). You will find an example of this in the ALEX lesson “Investigating school safety and slope”. A podcast sample and photo’s are included in this packet.

For help with slope basics:



[Slope Slider - visualize changes](#) This slope slider works with both fraction and decimal slopes with equations in the $y=mx+b$ format. You can also visualize change on the y-intercept; a great opening for a discussion of parallel lines.



Thinking about slope: Ex: Think of a capital letter that has two undefined slopes, one positive and one negative: Answer: M

Course of Study Item #3

Determine properties of a relation, including domain, range, and whether it is a function, when given graphs, tables of values, mappings, or sets of ordered pairs.



PowerPoint included derived from AMSTI Activities to introduce discussion on functions. Student activity included. Solutions included in dialog box at bottom of PowerPoint.



Draw mappings on a board or Interwrite pad, ask students to alter your drawing to change its functionality (ex: if you have drawn a function, have them make changes so that it is not a function).



Make a poster where every student can add a rough sketch of a graph that is NOT a function. Let your struggling students begin, then pass it on to your more creative students. They don’t have to be able to write the corresponding equation...they may come up with an ellipse, circle, anything.

Course of Study Item #4

Construct graphs of common relations, including $x = \text{constant}$, $y = \text{constant}$, $\sqrt{\quad}$, and $||$.



[Graph Trig Functions](#) (and parabolas)



Use graphing calculators (or graph paper) to construct equations such as $y = x+1$; $y = x^2+1$ and $y = |x|+1$...let students notice the similar y intercept, shift the graphs and discuss.

Course of Study Item #5

Perform operations of addition, subtraction, and multiplication on polynomial expressions.

- Dividing a polynomial by a monomial
- Evaluating polynomial functions



Put a long polynomial expression on the board – have student identify terms that are the same and justify their response (the justification is crucial for listening students who don't understand the correct response).



Using another long polynomial expression, have students rewrite in a dark marker on top of poster board, then line by line re-write the expression using colors or shapes (see 'Color this polynomial simplified' – ALEX). Ex: $2x^2 + 3x - 7x^2 + 10x - 3$ then $\rightarrow -5x^2 + 13x - 3$ Display their colorful work on the wall.

Course of Study Item #6

Use GCF, difference of squares, perfect square trinomials, and grouping to factor binomials, trinomials, and other polynomials.



[FactorizeTwo](#)



[Factorize](#) this applet helps a student visualize factors of whole numbers 1-50.



[the factor game](#) pairs of student compete to factor numbers



[Visualize Factoring](#) $(a+b)^2$

Course of Study Item #7

Solve multistep equations and inequalities, including linear, radical, absolute value, and literal equations.



Give students a multi-step equation in the form of a two-column proof (justify each step). Cut apart the steps and justifications, have the arrange the equation correctly on a sheet of colored paper and glue down (when checked for correctness).

Course of Study Item #8

Solve systems of linear equations and inequalities in two variables graphically and algebraically.



[Pan Balance](#) Compare equations on a graph: one solution, no solution, infinite solutions. Similar to looking at equations on a graphing calculator.

Course of Study Item #9

Solve quadratic equations using the zero product property.

- Determining approximate solutions of quadratic equations graphically and numerically
- Solving quadratic equations using the quadratic formula and completing the square



Poster Project. Give each student or group a factorable quadratic. Have them show all three (or more) methods of solutions for the equation on the poster (or in a PowerPoint): Graphing, formula, factoring (complete the square). **Many Algebra IA/IB teachers are postponing 'complete the square' method until the proof is discussed in Algebra II.*

Course of Study Item #10

Calculate length, midpoint, and slope of a line segment when given coordinates of its endpoints on the Cartesian plane.

- Deriving distance, midpoint, and slope formulas for line segments
- Utilizing the Pythagorean Theorem to solve application-based problems



[Pythagorean Explorer](#)



[Pythagorean Theorem without words](#) visualize the Pythagorean theorem

Course of Study Item #11

Solve problems algebraically involving area and perimeter of a polygon, area and circumference of a circle, and volume and surface area of right circular cylinders or right rectangular prisms.

- Applying area and volume formulas to solve application-based problems



[Circle Tool](#) Compare area and circumference to radius & diameter.



[Computing Pi](#) compute Pi with inscribed polygons

Course of Study Item #12

Compare various methods of data reporting, including scatterplots, stem-and-leaf plots, histograms, box-and-whisker plots, and line graphs, to make inferences or predictions.

- Determining effects of linear transformations of data

Example: concluding that if the teacher adds 5 points to each student's grade on an algebra test with mean score of 78, the new mean score will be 83

- Determining effects of outliers
- Critiquing the design of a survey



[Histogram Creator](#)



[Mean, Median, Box and Whisker Creator](#)



[Box and Whisker Plotter](#)



[Circle Graphs](#) create your own from data gathered



To help students understand stem-leaf plots, ask them to name every teacher in the school and 'guess their age'. It's a fun, harmless activity that makes students reflect on their school community.

Course of Study Item #13

Identify characteristics of a data set, including numerical or categorical and univariate or bivariate.
Example: conducting a survey of 100 students to determine whether boys and girls prefer to watch the same genres of movies to get a bivariate, categorical data set



[Bar Grapher](#) Use this univariate bar grapher looking at provided data or by entering your own data. After looking at class results, consider asking ‘how would we graph this if we separated male/female results? Let the students create their own bivariate graphs on paper.

Course of Study Item #14

Use a scatterplot and its line of best fit or a specific line graph to determine the correlation existing between two sets of data, including positive, negative, or no correlation.



[Lines of Best Fit](#) An Illuminations applet where students can plug in data and view the line of best fit.



[Linear Regression Applet](#)

Course of Study Item #15

Calculate probabilities given data in lists or graphs.

- Comparing theoretical and experimental probabilities for data in lists or graphs



[Random Drawing tool](#)



[Adjustable Spinner](#) Calculate the probability of spinning and hitting specific colors on a wheel. Several activity links go along with the application.



[Theoretical and Experimental Probability](#)