ALGEBRA 1 STANDARDS

The DoDEA high school mathematics program centers around six courses which are grounded by rigorous standards. Two of the courses, AP Calculus and AP Statistics, are defined by a course syllabus that is reviewed and revised on an annual basis. The other 5 courses, Algebra 1, Algebra 2, Geometry, Discrete Mathematics and PreCalculus/Mathematical Analysis, have established standards designed to provide a sequence of offerings that will prepare students for their future goals. These standards serve as the foundation of a comprehensive effort to realize the vision for mathematics education of the students enrolled in DoDEA schools.

Vision: DoDEA students will become mathematically literate world citizens empowered with the necessary skills to prosper in our changing world. DoDEA educators' extensive content knowledge and skillful use of effective instructional practices will create a learning community committed to success for all. Through collaboration, communication, and innovation within a standards-driven, rigorous mathematics curriculum, DoDEA students will reach their maximum potential.

Guiding Principals

Standards:

- Clear and concise standards provide specific content for the design and delivery of instruction.
- Standards provide details that ensure rigor, consistency, and high expectation for all students.
- Standards identify the criteria for the selection of materials/resources and are the basis for summative assessment.

Instruction:

- The curriculum focuses on developing mathematical proficiency for all students.
- The instructional program includes opportunities for students to build mathematical power and balances procedural understanding with conceptual understanding.
- Effective teachers are well versed in mathematical content knowledge and instructional strategies.
- Classroom environments reflect high expectations for student achievement and actively engage students throughout the learning process.
- Technology is meaningfully integrated throughout instruction and assists students in achieving/exceeding the standards.

Assessment/Accountability:

- Assessment practices provide feedback to guide instruction and ascertain the degree to which learning targets are mastered.
- Assessments are used to make instructional decisions in support of the standards and measure standards-based student performance.
- All teachers of mathematics and administrators providing curriculum leadership should be held accountable for a cohesive, consistent, and standards-based instructional program that leads to high student achievement.

Mathematics Process Standards

The DoDEA PK-12 mathematics program includes the process standards: problem solving, reasoning and proof, communication, connections, and representation. Instruction in mathematics must focus on process standards in conjunction with all PK-12 content standards throughout the grade levels.

Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to: • build new mathematical knowledge through problem solving; • solve problems that arise in mathematics and in other contexts; • apply and adapt a variety of appropriate strategies to solve problems; • monitor and reflect on the process of mathematical problem solving.	**Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:** • recognize reasoning and proof as fundamental aspects of mathematics; • make and investigate mathematical conjectures; • develop and evaluate mathematical arguments and proofs; • select and use various types of reasoning and methods of proof.	**Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:** • organize and consolidate their mathematical thinking through communication; • communicate their mathematical thinking coherently and clearly to peers, teachers, and others; • analyze and evaluate the mathematical thinking and strategies of others; • use the language of mathematics to express mathematical ideas precisely.	**Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:** • recognize and use connections among mathematical ideas; • understand how mathematical ideas interconnect and build on one another to produce a coherent whole; • recognize and apply mathematics in contexts outside of mathematics.	**Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:** • create and use representations to organize, record, and communicate mathematical ideas; • select, apply, and translate among mathematical representations to solve problems; • use representations to model and interpret physical, social, and mathematical phenomena.

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Strand: **A1.1 Number Sense and Operations**
Students recognize and use properties and laws for operations with real numbers and algebraic expressions. Students analyze relationships among real numbers and ways of representing numbers.

Standards: Students in the Algebra I course will:

A1.1.1 Identify and use the properties of operations on real numbers, including commutative, associative, distributive, and identity and inverse elements for addition and multiplication;

Example: Which properties are illustrated by each of the following?

$15x(7y \bullet 9z) = 15x(9z \bullet 7y)$

$15x(7y \bullet 9z) = (15x \bullet 7y) \bullet 9z$

$-17x(-3+4) = 51x^2 - 60x$

$15x + (7y + 9z) = 15x + (9z + 7y)$

$15x + (7y + 9z) = (15x + 7y) + 9z$

A1.1.2 Use the binomial theorem to expand binomial expressions;

Example: Use the binomial theorem to expand $(1+x)^2$.

A1.1.3 Explain the relationship between real numbers and the number line (including the density property) and compare and order real numbers with and without the number line;

Example: Order the following on a number line.

$\sqrt{82}$, 3π, 8.9, 9, $\frac{37}{4}$, 9.3×10^0

Example: List these temperatures from lowest to highest.

$1.35 \bullet 10^2$

$2.08 \bullet 10^4$

$9.0 \bullet 10^3$

$4.5 \bullet 10^4$

Example: List three numbers between 5.612 and 5.613.

A1.1.4 Solve simple equations in one variable using inverse relationships between operations such as addition and subtraction (taking the opposite), multiplication and division (multiplying by the reciprocal), raising to a power and taking a root;

Example: Use inverse operations to isolate the variable and solve the equation.

$5x = 125$

$x - 13 = 29$

$x + 22 = 25$

$734{,}166 = x^9$

A1.1.5 Explain and use the laws of exponents, including fractional and integral exponents;

Example: Use the law of exponents to write a simplified version for the following expressions.

1. $x^a x^b$
2. $x^a x^a$
3. $\left(x^a\right)^b$
4. $\frac{x^a}{x^b}$
5. $\frac{x^a}{y^b}$
6. x^0
7. x^1
8. x^{-a}
9. $x^{\frac{1}{2}}$
10. $2 \bullet 2 \bullet 2 \bullet 2$

A1.1.6 Simplify numerical expressions, including those involving radicals and absolute value.

Example: Simplify $(8+16) \div 4 + 5$ using the distributive property and order of operations. Which way was faster? Why?

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Strand: **A1.2 Polynomials**
Students will perform basic operation and apply basic factoring techniques on polynomials.

Standards: Students in the Algebra I course will:

A1.2.1 Add, subtract, multiply, and divide monomials and polynomials and solve multistep problems by using these techniques;

Example:
Simplify each of the following expressions.

$$5a + (-2a) - (-4a)$$
$$2x \bullet 3x^2 \bullet -4x^3$$
$$(3x + 4)(1 + 2x)$$
$$\frac{-7ab^3c}{14a^4b^2c}$$

A1.2.2 Apply basic factoring techniques to second-degree polynomials;

Example: Use the graph of $y = x^2 + 5x + 4$ to determine the factors of $x^2 + 5x + 4$.

A1.2.3 Solve multistep problems that involve adding, subtracting, multiplying, and dividing rational expressions and reduce solutions to lowest terms by factoring the numerator and denominator;

Example: Simplify each of the following expressions.

a) $\frac{x^2 - 2x - 8}{x + 2}$ b) $\frac{2}{x} + \frac{3}{x^2} + \frac{1}{2x}$

c) $\frac{5x - 1}{x + 8} - \frac{3x + 4}{x + 8}$ d) $\frac{7x^2}{3} \bullet \frac{9}{14x}$

A1.2.4 Solve problems involving equations with algebraic fractions including direct, inverse, and joint variation.

Example: The amount of sales tax on a new car is directly proportional to the purchase price of the car. If a $25,000 car requires $1750 in sales tax, what is the purchase price of a new car which pays $3500 sales tax?

Example: Ohm's law states that the amount of current in a circuit is directly proportional to the voltage across the circuit and inversely proportional to the resistance of the circuit. A 600 watt microwave oven draws a current of 5.0 amperes. The resistance is 24 ohms. What is the resistance of a 200 watt refrigerator in the circuit that draws a current of 1.7 amperes?

Example: The time *t* required to plow a field varies directly as the area A of the field and inversely as the number *n* of men employed. If 15 men plow a 40 acre field in 5 days, how many men would be required to plow a 60 acre field in 4 days?

Strand A1.3 Linear Equations and Inequalities
Students will recognize linear patterns and work with a variety of representations for linear relations to solve problems.

Standards: Students in the Algebra I course will:

A1.3.1 Write an equation of a line when given the graph of the line, a data set, two points on the line, or the slope and a point of the line;

Example: Given the following information, write an equation to determine the cost of a taxi ride for any given distance.

- Each taxi ride begins with a minimum cost of $4.00. Each one-half mile segment costs $1.25.
- A 3 mile taxi ride costs $11.50.
- A 5 mile taxi ride costs $16.50.

A1.3.2 Describe and calculate the slope of a line given a data set or graph of a line, recognizing that the slope is the rate of change;

Example: The cost of upholstering a sofa is located in the table below:

Yards of Fabric	**Cost**
8	560
9	595
10	610
11	635
12	660

- What is the rate of change in cost from 8 yards to 12 yards?
- Graph the data in the table and draw a line through the points. Find the slope of the line.
- How is the slope related to the rate of change?
- Predict the cost of upholstering a sofa that requires 14 yards of fabric.

A1.3.3 For bivariate data that appear to form a linear pattern, find the line of best fit by estimating visually and/or using appropriate technology to determine the least squares regression equation. Interpret the slope of the equation for a regression line within the context of the data and use the equation to make predictions;

Example: The table below gives the age of a cat or dog and its corresponding age in human years.

C/D	0.5	1	2	4	6	8	10	14	18	21
Human	10	15	24	32	40	48	56	72	90	106

Draw a scatter plot of points for both animal and human age. Give coordinates of 2 points that lie on the line and find an equation for the line. Use this information to find the approximate human age equivalent to that of a 16 year old dog or cat.

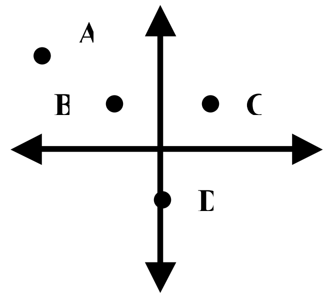
A1.3.4 Identify rates of change (slope) and distinguishing properties of data from tables, graphs, and equations to predict what happens to one variable as another variable changes;

Example: The billing plan for two cell phone companies is given in the table below. Determine when the $.45 per minute is the better plan.

Cell Phone Plan A	**Cell Phone Plan B**
$.30 per minute Plus $25.00 per month	$.45 per minute Plus $10.00 per month

A1.3.5 Describe and analyze lines that have positive, negative, zero and undefined slopes;

Example: Explain how to tell if the slope of a line is positive, negative, or zero by looking at its graph.



- Name two points on a line with positive slope.
- Name two points on a line with negative slope
- Name two points on a line with zero slope.

Example: Explain how to tell if the slope of a line is positive, negative, or zero by looking at a table of values.

A1.3.6 Represent linear relationships graphically, algebraically (including the slope-intercept form) and verbally and relate a change in the slope or the y-intercept to its effect on the various representations;

Example: A 16 ft. extension ladder costs $50. The price of the ladder increases $7.50 for each additional foot of the ladder length. Let x = ladder length, and y= price. What is the cost of a 28 ft. ladder? List a possible point. Write an equation for a line which relates x and y. Find the slope of the line.

A1.3.7 Graph inequalities and shade the regions that they define;

Example: A person has less that $4.00 all in quarters or dimes. Let x = the number of quarters and y = the number of dimes the person has. Write an inequality to describe this situation. Graph the possible numbers of quarters and dimes the person might have.

A1.3.8 Verify if a point lies on the graph of a line from tables, graphs and equations;

Example: Decide if the point (-3, 3) lies on the graph of $x + 3y = 6$.

A1.3.9 Understand and identify characteristics (parallel, perpendicular, horizontal, vertical) of linear functions and be able to determine linear equations to match given characteristics;

Example: Graph each of the following pairs of lines and explain why they are perpendicular, horizontal, vertical, and/or parallel.

1. $y = 3x + 8$ and $y = 3x - 4$
2. $x = 4$ and y = -3
3. $y = -\frac{1}{3}x + 2$ and $y = 3x - 4$

A1.3.10 Solve multistep problems involving linear equations and/or inequalities (including those with absolute value) in one variable and provide justification for each step;

Example: Solve the equation 5(2x + 12)=5x – 5 for *x* and justify each step of your solution.

A1.3.11 Apply and use linear equations and/or inequalities as mathematical representations of proportional relationships to solve problem; including rate problems, work problems, and percent mixture problems;

Example: Mei-Ling from Singapore was preparing to travel to South Africa for three months as an exchange student. She needed to change Singapore dollars (SGD) for South African rand (ZAR). On returning to Singapore after three months she had 3900 ZAR left. With the exchange rate at 1 SGD=4 ZAR, how much money in Singapore dollars did Mei-Ling receive? If the exchange rate was 1 SGD = 4.2 ZAR when she purchased the ZAR prior to here trip, did she gain or lose money and how much?

A1.3.12 Represent and solve problems that can be modeled using a system of linear equations and/or inequalities in two variables, sketch the solution sets, and interpret the results within the context of the problem.

Example: The science club decides to sell T-shirts to earn money for a new Van de Graaff generator. A company will sell you T-shirts at $5.85 and charge $23.50 to set up the screen printing with your school logo. Write an equation describing the expense you incur to have the T-shirts printed. If you plan to sell the T-shirts for $8.00, set up a system of equations to determine the number of T-shirts that will have to be sold in order to make a profit. How many shirts will need to be sold to purchase a $348 generator?

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Strand: **A1.4 Quadratic Functions and Equations**
Students graph quadratic functions and solve problems involving quadratic relationships.

Standards: Students in the Algebra I course will:

A1.4.1 Recognize the characteristic shape of the graph of a quadratic function and describe its line of symmetry, vertex, and intercepts;

Example: Graph the equation $y = x^2 + 5x + 6$ and describe the vertex and line of symmetry.

A1.4.2 Determine solutions to quadratic equations (with real roots) by graphing, factoring, completing the square, or using the quadratic formula;

Example: For what values of c does $f(x) = x^2 - 6x + c$ have two real roots, one real root, and no real roots?

Example: Between the years 1980 and 2000 the average cost of a new home increase according to the model $C = 80.t^2 + 4550t + 41925$ where t represents the year with t=0 representing 1980. According to this model, when would the average cost of a new home have reached $200,000?

A1.4.3 Graph a quadratic polynomial and explain the relationship among the solutions, the zeros, the x-intercepts, and the factors;

Example: Graph the equation $y = 3x^2 - 15x + 19$ using a graphing calculator and use the tracing function to find estimates for the zeros of the graph.

A1.4.4 Translate between the standard form of a quadratic equation, the vertex form, and the factored form. Graph and interpret the relationships between the equation and the graph for each form.

Example: Find the zeros and line of symmetry for $y = x^2 - 4$. If $y = x^2 - 4$ has a maximum or minimum value, give the ordered pair corresponding to the maximum or minimum point.

Strand: **A1.5 Data Analysis**
Students display data in a variety of forms and approximate linear models for appropriate data.

Standards: Students in the Algebra I course will:

A1.5.1 Select, create, and interpret an appropriate graphical representation (e.g., scatterplot, table, stem-and-leaf plots, histogram, circle graph, etc) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data;

Example: In your research to purchase a 2008 SUV you collect the data in the table below. Create appropriate graphical representations for the following car dealer prices. Select which dealer you consider to have the best prices and use appropriate statistics to justify your choice.

2008 SUV Prices								
Dealer A			Dealer B			Dealer C		
$7,500	$8,500	$10,500	$9,500	$10,500	$10,500	$7,500	$8,500	$10,500
$10,500	$11,000	$12,000	$10,500	$11,000	$12,000	$10,500	$11,000	$12,000
$15,000	$15,000	$18,000	$13,000	$15,000	$16,000	$15,000	$15,000	$18,000

A1.5.2 Approximate a line of best fit (trend line) given a set of data (e.g., scatterplot). Use technology when appropriate.

Example: Use the data for land speed records in the table below to find an equation for a line of best fit. Then use the equation to predict when the sound barrier (768 mph) should have been broken. Compare this to the actual date of 1997 when a British car with a jet engine accomplished the feat and determine the percent error from your prediction.

Year	1910	1920	1931	1935	1939	1947	1965	1970	1983
Speed	131.7	155.0	246.9	301.1	368.9	394.2	600.6	622.4	633.6