

## **Anchorage School District High School Math Performance Standards**

### **PROGRAM STATEMENT**

Mathematical literacy is essential for every individual in today's technological society. A working knowledge of mathematics is needed to deal with the qualitative, quantitative, and spatial relationships that are encountered in everyday life. Therefore, the overall goal of the Mathematics Program for the Anchorage School District is to provide the opportunity for all students to learn, use, communicate, apply, appreciate, and enjoy the mathematics appropriate for their age, needs and ambitions.

### **GENERAL PROGRAM GOALS**

Students will be able to:

1. Use problem-solving approaches to investigate and understand mathematical content.
2. Formulate problems from everyday and mathematical situations.
3. Develop and apply strategies to solve a wide variety of problems.
4. Verify and interpret results with respect to the original problem.
5. Acquire confidence in using mathematics meaningfully.
6. Relate physical materials, pictures, and diagrams to mathematical ideas.
7. Reflect on and clarify thinking about mathematical ideas and situations.
8. Relate everyday language to mathematical language and symbols.
9. Realize that representing, discussing, reading, writing, and listening are vital parts of learning math.
10. Formulate logical conclusions.
11. Use models, known facts, properties, and relationships to explain thinking.
12. Use patterns and relationships to analyze mathematical situations.
13. Relate various representations of concepts or procedures to one another.
14. Make and evaluate mathematical conjectures; justify answers and solutions; validate thinking.
15. Appreciate the pervasive use and power of reasoning as a part of mathematics.
16. Link conceptual and procedural knowledge; recognize relationships among different topics in mathematics; see mathematics as an integrated whole.
17. Explore problems and describe results using graphical, numerical, physical, and verbal models or representations.
18. Use mathematical ideas to further understanding of other mathematical ideas.
19. Use and apply mathematics in other curriculum areas; use mathematics in daily life.
20. Value the role of mathematics in culture and society.

## PRE-ALGEBRA PERFORMANCE STANDARDS

Each ASD mathematics course reflects the program statement and incorporates the general program goals. In addition, each course consists of a specific set of standards that determine the course content and a set of performance standards that delineate what a student should be able to do after successfully completing the course. After satisfactorily completing the ASD Pre-Algebra curriculum, a student will be proficient in the ten strands of mathematics which comprise the Pre-Algebra Math Content Standards. As evidence of proficiency, the student will be able to:

### **P:1 Estimation**

- .1 Use estimation to check the reasonableness of answers involving real numbers.
- .2 Explain when an estimate is appropriate and when an exact answer is needed.
- .3 Use estimation to check calculator or computer accuracy.
- .4 Estimate the square root of a number.
- .5 Select appropriate scales or graphing windows for graphing data.

### **P:2 Number Sense**

- .1 Convert between fractions, decimals, and percents.
- .2 Compare and order real numbers using  $>$ ,  $<$ ,  $=$ , and  $\_$ .
- .3 Simplify expressions using rules of divisibility.
- .4 Write the prime factorization of a number using exponents.
- .5 Find greatest common factors (GCF) and least common multiples (LCM) using prime factorization.
- .6 Solve problems using ratio, proportion, percent, and unit pricing.
- .7 Solve problems using equivalent fractions, decimals, or percents.
- .8 Explain and use a variety of problem solving strategies.
- .9 Perform simple operations in other number systems and bases.

### **P:3 Concept of Number Operations**

- .1 Use appropriate vocabulary for effective communication in mathematics.
- .2 Use manipulatives, diagrams, symbols, and words to demonstrate addition, subtraction, multiplication, and division of real numbers.
- .3 Use identity and inverse properties of addition and multiplication to solve problems.
- .4 Use commutative and associative properties of addition and multiplication to solve problems.
- .5 Use the distributive property of multiplication over addition to solve problems.
- .6 Solve one and two step equations using the properties of equality and check the solutions.
- .7 Solve one and two step inequalities using the properties of inequality and check the solutions.
- .8 Convert between standard and scientific notation using both negative and positive exponents.

#### **P:4 Computation**

- .1 Add, subtract, multiply and divide fractions, decimals and integers with and without a calculator.
- .2 Write and solve problems involving order of operations.
- .3 Solve problems using percent of increase and decrease.
- .4 Perform basic operations on expressions involving exponents and square roots.
- .5 Simplify expressions involving absolute value of real numbers.
- .6 Solve problems with real numbers using paper and pencil, mental math, and a calculator.

#### **P:5 Geometry**

- .1 Identify, classify and compare triangles and quadrilaterals.
- .2 Identify, classify and compare regular and irregular polygons.
- .3 Identify, classify and compare simple polyhedra.
- .4 Construct or draw geometric figures in two-dimensions and three-dimensions.
- .5 Create three-dimensional models from two-dimensional views.
- .6 Solve problems using the relationships of angles formed by parallel, perpendicular and intersecting lines.
- .7 Describe the relationship of angles in different types of polygons.
- .8 Identify corresponding parts in similar and congruent geometric figures.
- .9 Find missing angles or sides of figures using similarity and congruence.
- .10 Describe the symmetry found in various figures.
- .11 Identify and graph reflections, rotations and translations on the Cartesian plane and describe these transformations in words and symbols.
- .12 Find the perimeter and area of various polygons.
- .13 Find the circumference and area of any circle.
- .14 Find the surface area and volume of various polyhedra.
- .15 Apply the Pythagorean Theorem to real-world situations.
- .16 Design a shape that will tessellate and use it to cover a surface.

#### **P:6 Measurement**

- .1 Use, compare, and convert between units in the metric system for length, mass, area, and volume.
- .2 Use, compare, and convert between units in the standard system for length, time, weight, area, and volume.
- .3 Compare units of measurement in the metric system to similar units of measurement in the standard system.
- .4 Apply multiple strategies, including formulas and manipulatives, to find area, perimeter, surface area, and volume, and include labels in appropriate units.
- .5 Solve practical problems involving proportion and scale.
- .6 Solve practical problems involving conversion between degrees Celsius and degrees Fahrenheit.
- .7 Solve practical problems involving rate, time, and distance.

**P:7 Statistics**

- .1 Create circle graphs using percents.
- .2 Present experimental or collected data using both paper and pencil, and technology, in various forms including a table, scatter plot, circle graph, line graph, stem-and-leaf, box-and-whiskers, and histogram.
- .3 Calculate mean, median, mode and range for a given set of data in a table or a graph.
- .4 Approximate a line of best fit or trend line for a given set of data.
- .5 Analyze data using patterns or trend lines and use this information to predict future outcomes, influence decisions, and defend conclusions.

**P:8 Probability**

- .1 Calculate the probability of a simple event.
- .2 Express the probability of an event using decimals, ratios, or percents.
- .3 Calculate the probabilities of independent events.
- .4 Conduct an experiment and use the data to find the probability of a simple event.

**P:9 Patterns**

- .1 Identify and expand classic patterns such as primes, square and triangular numbers, and Pascal's Triangle.
- .2 Express an arithmetic pattern as a rule and determine the  $n$ th term.
- .3 Apply patterns as a strategy for solving problems.

**P:10 Algebra**

- .1 Use proper algebraic terminology in both written and oral communication.
- .2 Present work in an organized and orderly fashion.
- .3 Simplify expressions using the properties of real numbers.
- .4 Solve one and two step equations.
- .5 Solve and graph one and two step inequalities.
- .6 Provide a verbal and written explanation for solutions.
- .7 Translate word problems into numerical expressions, inequalities, or equations.
- .8 Create word problems from symbolic statements.
- .9 Create a table of values from a linear function.
- .10 Graph the equation of a line in slope and  $y$ -intercept form.
- .11 Compute the slope of a line given two points.
- .12 Solve problems involving algebraic expressions using order of operations, grouping symbols, and exponents..

## ALGEBRA I PERFORMANCE STANDARDS

Each ASD mathematics course reflects the program statement and incorporates the general program goals. In addition, each course consists of a specific set of standards that determine the course content and a set of performance standards that delineate what a student should be able to do after successfully completing the course. After satisfactorily completing the ASD Algebra I curriculum, a student will be proficient in the seven strands of mathematics which comprise the Algebra I Math Content Standards. As evidence of proficiency, the student will be able to:

### **A1:1 Number Sense**

- .1 Classify numbers as Real, Irrational, Rational, Integer, Whole, Natural.
- .2 Compare the differences and similarities among rational, irrational, whole, integral, and natural numbers and represent these relationships using Venn diagrams.
- .3 Compare and order real numbers using  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $-$ , and  $=$ .
- .4 Compute a rational approximation for an irrational number.
- .5 Use prime factors to find the greatest common factors (GCF) and least common multiple (LCM) of a set of monomials.

### **A1:2 Computation**

- .1 Add, subtract, multiply, and divide signed numbers and variables.
- .2 Convert decimals, fractions, or percents to most useful form in various situations.
- .3 Write radicals in simplest radical form.
- .4 Use a calculator to evaluate a numeric expression involving roots and exponents.
- .5 Evaluate formulas including the quadratic formula, distance formula, slope and midpoint formulas.
- .6 Convert between scientific notation and standard decimal form.
- .7 Multiply and divide numbers written in scientific notation.
- .8 Identify the dimensions of a matrix.
- .9 Add and subtract matrices.
- .10 Multiply a matrix by a scalar.
- .11 Use appropriate units to label solutions to application problems.
- .12 Use unit analysis with standard and metric systems.
- .13 Evaluate and simplify algebraic expressions using order of operations.

### **A1:3 Geometry/Graphs**

- .1 Compute area and perimeter or circumference of polygons and circles.
- .2 Compute the surface area and volume of solid figures.
- .3 Use the Pythagorean theorem to determine the length of a side of a right triangle.
- .4 Determine if the coordinates of a point satisfy the equation of a graph.
- .5 Find the distance between two points on a number line.
- .6 Find the distance between two points on a coordinate plane.
- .7 Determine the slope of a line given the graph or two points on the graph.

- .8 Graph linear, quadratic, and absolute value equations and inequalities.
- .9 Classify graphs that are linear, quadratic, and absolute value equations or functions.
- .10 Explain how the graph of a line changes when the slope or y-intercept changes.

#### **A1:4 Probability**

- .1 Create a sample space to illustrate all possible outcomes of a simple or compound event.
- .2 Compute probability for simple and compound events.
- .3 Solve probability problems represented as area models.

#### **A1:5 Statistics**

- .1 Construct tables, charts, scatter plots, and graphs from given data.
- .2 Make predictions based on data from a table, chart or graph.
- .3 Compute mean, median, and mode for a set of data.
- .4 Compute the range of a set of data.
- .5 Represent data in a matrix.
- .6 Estimate a line of best fit for a given set of data.

#### **A1:6 Problem Solving**

- .1 Use various problem solving strategies including estimation, systematic lists, diagrams, patterns, guess and check, working backward, and solving a simpler problem.
- .2 Check the reasonableness of answers using estimation.
- .3 Write equations and inequalities to represent word problems.
- .4 Graph and compare functions with and without a graphing calculator.
- .5 Enter and run a simple program using a graphing calculator or computer.
- .6 Create a spreadsheet (such as a table of function values) to display information.
- .7 Select and use appropriate method for computing: estimation, mental math, pencil and paper, calculator, or computer.

#### **P:7 Algebra**

- .1 Use correct algebraic vocabulary and notation in both written and oral communication.
- .2 Write clear, step-by-step solutions to problems.
- .3 Apply the properties of real numbers to simplify expressions.
- .4 Solve linear equations and inequalities in one variable.
- .5 Solve a literal equation or formula for a given variable.
- .6 Convert a linear equation to slope-intercept form and graph it.
- .7 Simplify expressions containing exponents and radicals.
- .8 Add, subtract, multiply and divide polynomials.
- .9 Classify polynomials by degree and by number of terms.
- .10 Use a variety of techniques to factor polynomial expressions, including the greatest common factor, difference of two squares, perfect square trinomial, grouping, and trial and error.
- .11 Simplify, add, subtract, multiply, and divide rational expressions.
- .12 Simplify complex fractions.

- .13 Solve problems using ratio and proportion.
- .14 Solve systems of linear equations using the addition method, substitution method, and by graphing.
- .15 Solve systems of inequalities by graphing.
- .16 Solve absolute value equations and inequalities.
- .17 Find the union and intersection of sets using methods that include Venn diagrams and number-line intervals.
- .18 Solve problems containing "and" or "or" statements.
- .19 Solve quadratic equations by factoring and using the Zero Product Property.
- .20 Solve quadratic equations using the quadratic formula.
- .21 Solve equations involving rational expressions and/or radicals.
- .22 Write an equation for a line given its graph, a description of its graph, or a set of data.
- .23 Determine the values of unknown variables given equal matrices.
- .24 Determine whether a given relation is a function.
- .25 Identify the domain and range from the graph of a function, relation, or a set of ordered pairs.
- .26 Write an equation or rule from a set of paired data.
- .27 Evaluate an equation expressed in function notation.
- .28 Solve real world problems by applying the concepts and skills of algebra.

# GEOMETRY PERFORMANCE STANDARDS

Each ASD mathematics course reflects the program statement and incorporates the general program goals. In addition, each course consists of a specific set of standards that determine the course content and a set of performance standards that delineate what a student should be able to do after successfully completing the course. After satisfactorily completing the ASD Geometry curriculum, a student will be proficient in the nine strands of mathematics which comprise the Geometry Math Content Standards. As evidence of proficiency, the student will be able to:

## **G:1 Number Sense**

- .1 Validate numerical solutions for application problems.
- .2 Describe the number " **$\pi$** " and its relationship to a circle.
- .3 Determine the circumference and area of circles and the surface area and volume of cylinders and spheres.
- .4 Sketch diagrams that represent given information about measures of segments and angles.
- .5 Explain restrictions on variables representing angles and lengths.

## **G:2 Computation**

- .1 Simplify expressions involving radicals and exponents.
- .2 Simplify complex fractions.
- .3 Evaluate formulas relevant to geometry including distance, midpoint, area, perimeter, volume, Pythagorean theorem, and quadratic formula.
- .4 Set up and solve proportions involving similar figures.
- .5 Compute measures of unknown parts of a right triangle using the sine, cosine, and tangent ratios.

## **G:3 Measurement**

- .1 Model and measure basic geometric figures using a variety of methods including paper folding, compass, straight edge, protractor, and technology.
- .2 Use compass and straight edge for basic constructions.
- .3 Use appropriate units to label solutions of application problems.

## **G:4 Theory**

- .1 Communicate both orally and in writing, using correct geometric vocabulary and notation.
- .2 Explain the difference among definitions, postulates/axioms, and theorems.
- .3 Explain the importance of the Parallel Postulate in Euclidean geometry.
- .4 Classify problems as classical Euclidean geometry, coordinate geometry, or transformational geometry.
- .5 Explain the difference between inductive and deductive reasoning.

### **G:5 Deduction**

- .1 State the converse, inverse and contrapositive of a conditional statement and determine the validity of each.
- .2 Rewrite an "if and only if" statement into two conditional statements and vice versa.
- .3 Prove conjectures related to geometric figures using paragraph proofs, indirect proofs, two-column proofs, and coordinate geometry proofs.
- .4 Prove triangles are congruent using SSS, SAS, ASA, AAS, and HL.
- .5 Use definitions of terms related to triangles (i.e. altitude, median, angle bisector, isosceles, etc.) to deduce other properties of triangles.
- .6 Develop and explain the properties of trapezoids, parallelograms, rectangles, rhombuses, kites, and squares using the definitions of the various quadrilaterals.
- .7 Prove two triangles are similar and write a valid proportion showing the relationship between the corresponding sides.
- .8 Prove conjectures related to angles, parallel lines, and planes.

### **G:6 Diagrams and Models**

- .1 Select appropriate theorems to prove or disprove conjectures related to geometric figures.
- .2 Identify, classify, and draw two-dimensional and three-dimensional figures.
- .3 Draw and label triangles illustrating the congruency relationships of SSS, SAS, ASA, AAS, and HL.
- .4 Identify and label corresponding parts of overlapping triangles.
- .5 Identify and label congruent non-coplanar triangles in a three-dimensional diagram.
- .6 Draw and label similar figures showing the correct relationship between corresponding parts.
- .7 Solve problems involving triangles, quadrilaterals, and other polygons using appropriate terminology and properties.
- .8 Identify and label angles, segments, and lines as they relate to circles, and use the properties to solve problems.
- .9 Explain the difference among alternate interior angles, alternate exterior angles, corresponding angles, supplementary angles, and vertical angles formed by two lines and a transversal.
- .10 Model and explain parallel, perpendicular, skew, and oblique lines.
- .11 Describe the relationships of planes in space.
- .12 Find interior and exterior angle measures of regular polygons.
- .13 Confirm the validity of conjectures or provide a counter example using appropriate technology.

### **G:7 Probability**

- .1 Construct a sample space and list all possible outcomes of a particular event.
- .2 Use probability to solve problems presented as geometric models.

**G:8 Patterns**

- .1 Solve problems using the inequality relationships between the sides and angles of a triangle.
- .2 Identify and use patterns from right triangles, including  $30^\circ$ - $60^\circ$ - $90^\circ$ ,  $45^\circ$ - $45^\circ$ - $90^\circ$ , and Pythagorean triples to solve application problems.
- .3 Identify and describe patterns that emerge from two-dimensional and three-dimensional geometric figures and use the patterns to solve problems.
- .4 Identify, explain, and transform geometric figures using reflections, rotations, and translations on geometric figures.

**G:9 Algebra**

- .1 Write and solve equations that model geometric relationships.
- .2 Simplify and solve equations that result from formulas.
- .3 Solve application problems using the appropriate formula or relationships.

## ALGEBRA II PERFORMANCE STANDARDS

Each ASD mathematics course reflects the program statement and incorporates the general program goals. In addition, each course consists of a specific set of standards that determine the course content and a set of performance standards that delineate what a student should be able to do after successfully completing the course. After satisfactorily completing the ASD Algebra II curriculum, a student will be proficient in the six strands of mathematics which comprise the Algebra II Math Content Standards. As evidence of proficiency, the student will be able to:

### **A2:1 Number Sense**

- .1 Use estimation to check reasonableness of answers.
- .2 Select appropriate scales when graphing application problems.
- .3 Set an appropriate window when graphing with a graphing calculator.
- .4 Estimate an equation for a line or curve that models the scatter plot for a given set of data.
- .5 Identify and classify subsets of the complex number system as natural, whole, integer, rational, irrational, real, or imaginary.
- .6 Determine appropriate domain and range for application problems.
- .7 Determine restrictions for variables appearing in rational and radical expressions so that the statement will be meaningful.
- .8 Use appropriate units to label solutions of application problems.

### **A2:2 Geometry**

- .1 Graph linear functions accurately with pencil and paper given slope- intercept form.
- .2 Graph quadratic functions accurately with pencil and paper given vertex form.
- .3 Label a geometric figure using algebraic expressions and write a valid relationship involving the expressions.
- .4 Identify and graph parent functions including constant, linear, quadratic, cubic, absolute value, exponential, logarithmic, and reciprocal.
- .5 Transform parent functions using translation, reflection, stretching and/or shrinking.
- .6 Graph equations having discontinuities such as asymptotes and/or holes.
- .7 Identify and explain types of symmetry.
- .8 Sketch the graphs of circles, ellipses, hyperbolas, and parabolas given in standard form.
- .9 Use the formulas of coordinate geometry including slope, midpoint, distance, and equations of lines from memory.
- .10 Explain the geometric interpretation of real zeros of a function.

### **A2:3 Statistics**

- .1 Read and interpret data displayed in a table, chart or graph.
- .2 Organize and display data using stem-and-leaf plots, box-and-whisker plots, histograms, and scatter plots.
- .3 Determine a line or curve of best fit for a given set of data.

- .4 Use a regression equation that models a set of data to make predictions.
- .5 Determine the mean, median, mode, and range for a set of data.
- .6 Determine the percentile rank of a data point.
- .7 Explain the difference between percentile and percentage.
- .8 Calculate the standard deviation for a set of data that is normally distributed.
- .9 Determine the reasonableness of statistical conclusions applied to real-world situations.

#### **A2:4 Probability**

- .1 Explain the difference between combinations and permutations.
- .2 Select and use appropriate formulas to solve problems involving combinations and permutations.
- .3 List all possible outcomes for a particular event.
- .4 Explain the differences among independent, dependent, and mutually exclusive events.
- .5 Compute probabilities for simple and compound events.
- .6 Solve problems involving conditional probability.
- .7 Explain the difference between experimental probability and theoretical probability.

#### **A2:5 Patterns**

- .1 Develop a rule for a sequence and represent that rule recursively, explicitly, or verbally.
- .2 Identify a sequence as arithmetic, geometric, or neither.
- .3 Factor polynomial expressions using a variety of patterns including difference of two squares, sum or difference of two cubes, perfect square trinomials, and grouping.
- .4 Use Pascal's triangle to find the coefficients for a binomial expansion.
- .5 Use the Binomial theorem to find a particular term of a binomial expansion.
- .6 Determine if two variables vary directly or inversely and, if applicable, find the constant of variation.

#### **A2:6 Algebra**

- .1 Determine whether a given relation is a function.
- .2 Identify the domain and range of a function.
- .3 Find the inverse of a function if it exists and describe it graphically.
- .4 Add, subtract, multiply, divide, and compose functions, and identify the domain and range of the new function.
- .5 Graph a piece-wise function.
- .6 Add, subtract, multiply, and use scalar multiplication on matrices.
- .7 Simplify rational expressions and radicals.
- .8 Solve problems that contain radicals and rational expressions.
- .9 Simplify expressions involving fractional exponents.
- .10 Add, subtract, multiply, and divide complex numbers, and simplify the results.
- .11 Solve quadratic equations by factoring, using the quadratic formula, and graphing.
- .12 Solve quadratic equations that have complex roots.

- .13 Identify the conic sections and use completing the square to rewrite them in standard form.
- .14 Solve problems involving "and" and "or" statements.
- .15 Solve literal equations and formulas for a given variable.
- .16 Solve a system of three equations in three unknowns using the substitution method and/or addition method.
- .17 Use matrices and a graphing calculator to solve systems of linear equations.
- .18 Solve systems of non-linear equations.
- .19 Use the rational root theorem and the factor theorem to find rational roots of equations of degree three or more.
- .20 Use synthetic division to divide a polynomial by a binomial of the form  $x-a$ .
- .21 Solve inequalities using number lines and coordinate planes.
- .22 Represent a series using sigma notation.
- .23 Find partial sums of arithmetic and geometric series.
- .24 Calculate the sum of an infinite geometric series with  $|r| < 1$ .
- .25 Identify, solve, and graph exponential and logarithmic functions.
- .26 Simplify expressions involving logarithms.
- .27 Solve equations by applying the properties of logarithms.
- .28 Solve for an unknown exponent using logarithms.
- .29 Apply algebra concepts and skills to solve real world problems.
- .30 Solve application problems using appropriate technology.