Alaska Mathematics Standards
Grade 8

Standards for Mathematical Content Grade 8

The Number System
Know that there are numbers that are not rational, and approximate them by rational numbers. 8.NS.1. Classify real numbers as either rational (the ratio of two integers, a terminating decimal number, or a repeating decimal number) or irrational. 8.NS.2. Order real numbers, using approximations of irrational numbers, locating them on a number line. *For example, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.* 8.NS.3. Identify or write the prime factorization of a number using exponents. L
Expressions and Equations
Work with radicals and integer exponents. 8.EE.1. Apply the properties (product, quotient, power, zero, negative exponents, and rational exponents) of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$. 8.EE.2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. 8.EE.3. Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger.* 8.EE.4. Perform operations with numbers expressed in scientific notation, including problems where both standard notation and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. Interpret scientific notation that has been generated by technology. **Understand the connections between proportional relationships, lines, and linear equations.** 8.EE.5. Graph linear equations such as $y=mx+b$, interpreting m as the slope or rate of change of the graph and b as the y-intercept or starting value. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*

8.EE.6. Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.

Analyze and solve linear equations and pairs of simultaneous linear equations.

8.EE.7. Solve linear equations in one variable.

a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).

b. Solve linear equations with rational coefficients, including equations whose solutions require expanding expressions using the distributive property and combining like terms.

8.EE.8. Analyze and solve systems of linear equations.

a. Show that the solution to a system of two linear equations in two variables is the intersection of the graphs of those equations because points of intersection satisfy both equations simultaneously.

b. Solve systems of two linear equations in two variables and estimate solutions by graphing the equations. Simple cases may be done by inspection. *For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.*

c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For 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.*

Functions

Define, evaluate, and compare functions.

8.F.1. Understand that a function is a rule that assigns to each input (the domain) exactly one output (the range). The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. *For example, use the vertical line test to determine functions and non-functions*.

8.F.2. Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*

8.F.3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.*

Use functions to model relationships between quantities.

8.F.4. 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 a linear function in terms of the situation it models, and in terms of its graph or a table of values.

8.F.5. Given a verbal description between two quantities, sketch a graph. Conversely, given a graph, describe a possible real-world example. *For example, graph the position of an accelerating car or tossing a ball in the air.*

Geometry

Understand congruence and similarity using physical models, transparencies, or geometry software.

8.G.1. Through experimentation, verify the properties of rotations, reflections, and translations (transformations) to figures on a coordinate plane).
a. Lines are taken to lines, and line segments to line segments of the same length.
b. Angles are taken to angles of the same measure.
c. Parallel lines are taken to parallel lines.

8.G.2. Demonstrate understanding of congruence by applying a sequence of translations, reflections, and rotations on two-dimensional figures. Given two congruent figures, describe a sequence that exhibits the congruence between them.

8.G.3 .Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

8.G.4. Demonstrate understanding of similarity, by applying a sequence of translations, reflections, rotations, and dilations on two-dimensional figures. Describe a sequence that exhibits the similarity between them.

8.G.5. Justify using informal arguments to establish facts about
- the angle sum of triangles (sum of the interior angles of a triangle is 180º)
- measures of exterior angles of triangles,
- angles created when parallel lines are cut be a transversal (e.g., alternate interior angles) and
- angle-angle criterion for similarity of triangles.

Understand and apply the Pythagorean Theorem.

8.G.6. Explain the Pythagorean Theorem and its converse.

8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

8.G.9. Identify and apply the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Statistics and Probability

Investigate patterns of association in bivariate data.

8.SP.1. 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.SP.2. Explain why 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.SP.3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and y-intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*

8.SP.4. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects and use relative frequencies to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*

Standards for Mathematical Practice

Instruction around the Standards of Mathematical Practices is delivered across all grades K-12. These eight standards define experiences that build understanding of mathematics and ways of thinking through which students develop, apply, and assess their knowledge.

1. Make sense of problems and persevere in solving them.

- explain correspondences between a new problem and previous problems
- represent algebraic expressions numerically, graphically, concretely/with manipulatives, verbally/written
- explain connections between the multiple representations
- determine the question that needs to be answered
- analyze a problem and make a plan for solving it
- choose a reasonable strategy
- identify the knowns and unknowns in a problem
- use previous knowledge and skills to simplify and solve problems
- break a problem into manageable parts or simpler problems
- solve a problem in more than one way

2. Reason abstractly and quantitatively.

- represent a situation symbolically and carry out its operations
- create a coherent representation of the problem
- translate an algebraic problem to a real world context
- explain the relationship between the symbolic abstraction and the context of the problem
- compute using different properties
- consider the quantitative values, including units, for the numbers in a problem

3. Construct viable arguments and critique the reasoning of others.

- construct arguments using both concrete and abstract explanations
- justify conclusions, communicate conclusions, and respond to the arguments
- listen to arguments, critique their viability, and ask questions to clarify the argument
- compare effectiveness of two arguments by identifying and explaining both logical and/or flawed reasoning
- recognize general mathematical truths and use statements to justify the conjectures
- identify special cases or counter-examples that don't follow the mathematical rules
- infer meaning from data and make arguments using its context

4. Model with Mathematics.

- apply mathematics to solve problems arising in everyday life and society
- identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, and formulas
- interpret their mathematical results in the context of the situation and reflect on whether the results make sense
- make assumptions and approximations to simplify a situation, realizing the final solution will need to be revised
- analyze quantitative relationships to draw conclusions
- reflect on whether their results make sense

• improve the model if it has not served its purpose
5. Use appropriate tools strategically.
• select and use tools appropriate to the task: pencil and paper, protractor, visual and physical fraction models, algebra tiles, geometric models, calculator, spreadsheet, and interactive geometry software. • use estimation and other mathematical knowledge to confirm the accuracy of their problem solving • identify relevant external and digital mathematical resources and use them to pose or solve problems • represent and compare possibilities visually with technology when solving a problem • explore and deepen their understanding of concepts through the use of technological tools
6. Attend to precision.
• use clear definitions in explanations • understand and use specific symbols accurately and consistently: equality, inequality, ratios, parenthesis for multiplication and division, absolute value, square root • specify units of measure, and label axes to clarify the correspondence with quantities in a problem • calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context
7. Look for and make use of structure.
• discern a pattern or structure • understand complex structures as single objects or as being composed of several objects • check if the answer is reasonable
8. Look for and express regularity in repeated reasoning.
• identify if calculations or processes are repeated • use alternative and traditional methods to solve problems • evaluate the reasonableness of their intermediate results, while attending to the details