Grade 8
Algebra Objectives

Number System

1. Classifies *real numbers* as either rational (the ratio of two integers, a terminating decimal, or a repeating decimal) or irrational (including decimals that neither terminate nor repeat, like π and the square root of 2) (8.NS.1) (8.EE.2)
2. Compares and contrasts the sets of counting numbers, whole numbers, integers, rational numbers, irrational numbers, and real numbers (e.g., using Venn diagrams)
3. Approximates the value of given irrational numbers
4. Recognizes the need for irrational numbers in the number system and in the real world
5. Orders real numbers, using approximations for irrational numbers, including locating them on a number line (e.g., showing that the square root of 2 is between 1 and 2, then showing that it is between 1.4 and 1.5, and then showing how to continue getting better approximations) (8.NS.2) (SMP 7) (SMP 8)
6. Converts any repeating decimal (including when only part of the decimal portion repeats) to a fraction
7. Gives the prime factorization of any whole number in exponential form (e.g., $750 = 5^3 \bullet 3 \bullet 2$) (8.NS.3)
8. Explains the purpose and uses of *scientific notation* (SMP 6)
9. Writes any integers, positive and negative decimals, and positive and negative mixed decimals from millionths through hundred trillions in scientific notation
10. Uses numbers expressed in scientific notation in the form of a single digit times an integer power of 10 to estimate very large and very small quantities and to determine how many times bigger one is than the other (e.g., estimates the population of the U.S. as 3×10^8 and the population of the world as 7×10^9 and determines that the population of the world is more than 20 times larger) (8.EE.3)
11. Interprets numbers expressed in scientific notation that have been generated by a calculator (8.EE.4)
12. Defines *square root* and uses the appropriate symbol (8.EE.2) (SMP 6)
13. Calculates the square root of any perfect square greater than 144 (8.EE.2) (SMP 6)
14. Defines *cube root*, uses the appropriate symbol, and identifies the cube root of perfect cubes through 125 (8.EE.2) (SMP 6)
15. Converts between mixed decimals and percents
16. Converts between mixed numbers and percents
17. Explains the concept of *bases* (SMP 6) (SMP 7)
18. Compares and contrasts the bases used in the number system used in the traditional Iñupiaq culture, in the decimal number system used in most of the U.S., and in the binary system (ACS D.5) (SMP 6) (SMP 7)
19. Discusses the ways that rational numbers other than whole numbers are handled in the Iñupiaq language and culture (ILF B.I.cb.1.1) (ACS A.5) (ACS D.5)
20. Uses numbers through 100 in Iñupiaq orally in everyday tasks (ILF B.I.cb.1.1) (ACS B.1) (ACS D.5)

Computation

1. Explains and performs multi-step addition, subtraction, multiplication, and division computations with rational numbers, using the correct order of operations (SMP 6) (SMP 8)
2. Adds and subtracts with numbers 0 through 99, using Kaktovik numerals (ILF B.I.cb.1.1) (ACS A.5) (ACS D.5)
3. Multiplies powers of 10 by adding exponents (SMP 6)
4. Divides powers of 10 by subtracting exponents (SMP 6)
5. Performs operations with numbers expressed in scientific notation, including problems where both standard notation and scientific notation are used (8.EE.4) (SMP 2) (SMP 6)
6. Solves multi-step real-world problems involving percents, including figuring percent increase (including in excess of 100 percent increase), percent decrease, markups, markdowns (discounts), sales tax, gratuities, and commissions and commission rates (SMP 4) (SMP 8)
7. Solves real-world problems involving compound interest, using a calculator (SMP 4) (SMP 5)
8. Uses a calculator to solve problems and to check the accuracy of his or her computations, as appropriate (SMP 5)

Expressions, Equations, and Inequalities

1. Uses an algebraic expression to find any term in a sequence (SMP 1) (SMP 2)
2. States the *domain* of a rational algebraic expression (e.g., for $(x + 5)/(x - 2)$, $x \neq 2$) (SMP 1)
3. Applies the properties of integer exponents (product, quotient, power, zero, negative exponents, and rational exponents) to generate equivalent numerical expressions (e.g., $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$) (8.EE.1) (SMP 1) (SMP 2)
4. Uses 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 (8.EE.2) (SMP 2) (SMP 6)
5. Graphs linear equations in the form $y = mx + b$, interpreting m as the slope or rate of change and b as the y-intercept or starting value (8.EE.5) (SMP 2)
6. Determines the slope of a line from its graph
7. Finds the slope of a line by computation, using $m = (y_2 - y_1)/x_2 - x_1)$ (SMP 2)
8. Graphs a simple equation by using the slope formula $(y_2 - y_1)/(x_2 - x_1)$ or $\Delta y/\Delta x$ and a point (SMP 2)
9. Compares two different proportional relationships represented in different ways (e.g., compares a distance–time graph to a distance–time equation to determine which of two moving objects has greater speed) (8.EE.5)
10. Uses similar triangles to explain why the slope m is the same between any two points on a non-vertical line in the coordinate plane (8.EE.6)
11. Derives 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 (8.EE.6)
12. Gives examples of linear equations in one variable with one solution, an infinite number of solutions, or no solutions, by successively transforming a 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) (8.EE.7a) (SMP 6)

13. Solves one-step and multi-step linear equations in one variable with rational coefficients, including equations whose solutions require expanding expressions using the distributive property and combining like terms (8.EE.7b) (SMP 2) (SMP 6) (SMP 8)
14. Solves one-step and multi-step linear inequalities in one variable with rational coefficients, including inequalities whose solutions require expanding expressions using the distributive property and combining like terms (SMP 2) (SMP 6) (SMP 8)
15. Shows 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 (8.EE.8a) (SMP 2) (SMP 6)
16. Solves systems of two linear equations in two variables and estimates solutions by graphing the equations or by inspection (e.g., $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously equal both 5 and 6) (8.EE.8b) (SMP 2) (SMP 6)
17. Solves real-world and mathematical problems involving two linear equations in two variables (e.g., 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.EE.8c) (SMP 2) (SMP 4) (SMP 6)
18. Calculates the distance between two points and the midpoints of line segments on a coordinate plane
19. Recognizes that a function is a rule that assigns to each *input* (the *domain*) exactly one *output* (the *range*) and that the graph of a function is the set of ordered pairs consisting of an input and the corresponding output (e.g., uses the vertical line test to determine functions and non-functions) (8.F.1) (SMP 6) (SMP 7)
20. Compares properties of two functions, represented in different ways, including algebraically, graphically, numerically in a table, or by verbal descriptions (e.g., given a linear function represented by a table of values and a linear function represented by an algebraic expression, determines which function has the greater rate of change) (8.F.2) (SMP 1) (SMP 7)
21. Interprets the equation $y = mx + b$ as defining a linear function, whose graph is a straight line (8.F.3)
22. Gives examples of functions that are not linear (e.g., the function $A = s^2$) (8.F.3)
23. Constructs a function to model a linear relationship between two quantities and interprets 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 (8.F.4) (SMP 7)
24. Sketches a graph, given a verbal description of the relationship between two quantities (e.g., graphs the position of an accelerating car) (8.F.5) (SMP 4)
25. Solves real-world and mathematical problems involving distance, rate, and time, using the memorized formula $D = rt$ (SMP 2) (SMP 4)
26. Identifies and uses the *reflexive property of equality* (that is, $a = a$) (SMP 2) (SMP 6)
27. Identifies and uses the *symmetric property of equality* (that is, if $a = b$, then $b = a$) (SMP 2) (SMP 6)
28. Identifies and uses the *transitive property of equality* (that is, if $a = b$ and $b = c$, then $a = c$) (SMP 2) (SMP 6)

29. Identifies and uses the *addition property of equality* (that is, if $a = b$, then $a + c = b + c$) (SMP 2) (SMP 6)
30. Identifies and uses the *multiplication property of equality* (that is, if $a = b$, then $a \bullet c = b \bullet c$) (SMP 2) (SMP 6)
31. Identifies and uses the *transitive property of inequality* (that is, if $a > b$ and $b > c$, then $a > c$) (SMP 2) (SMP 6)
32. Identifies and uses the *addition property of inequality* (that is, if $a > b$, then $a + c > b + c$) (SMP 2) (SMP 6)
33. Identifies and uses the *multiplication property of inequality* (that is, if $a > b$, then $a \bullet c > b \bullet c$) (SMP 2) (SMP 6)

Problem Solving, Reasoning, and Communication

1. Solves real-world multi-step problems with rational numbers, using any operations and the correct order of operations (SMP 2) (SMP 4) (SMP 8)
2. Determines relevant, irrelevant, and/or missing information in a given word problem (SMP 1)
3. Chooses the most appropriate method for solving a problem from a variety of problem-solving strategies and justifies that choice (SMP 1)
4. Distinguishes between *inductive reasoning* (observing individual cases and coming up with a new principle based on them) and *deductive reasoning* (taking accepted ideas and drawing a conclusion from them) (SMP 6)
5. Chooses between and uses inductive and deductive reasoning to solve real-world problems (SMP 1)
6. Interprets statements involving logical operations: *and*, *or*, *not*, and *if…then*
7. Interprets statements involving logical qualifiers: *every*, *each*, *all*, *some*, *no*, *at least*, *at most*, and *exactly*
8. Identifies, extends, and creates a variety of complex patterns involving rational numbers (including their squares, cubes, reciprocals, and multiples), units of measure, and geometric shapes, and uses symbolic notation to represent the patterns (SMP 2) (SMP 7)
9. Uses both alternative and traditional methods to solve problems (SMP 8)
10. Explains a variety of mathematical concepts and his or her reasoning in solving particular problems, orally and in writing (SMP 6)
11. Works cooperatively with others to use mathematics to solve complex problems in other school subjects (SMP 6)
12. Challenges both teachers' and students' mathematical arguments and conclusions, when appropriate, and seeks to improve them (SMP 3)
13. Believes that mathematical knowledge and skills are important to successful completion of high school subjects and high school graduation

Probability and Statistics

1. Designs and makes complex picture graphs, circle graphs (including when given percentages of data to be represented), line graphs, multiple-line line graphs, bar graphs, and double-bar bar graphs from real-world data, choosing an appropriate size for intervals and using correct titles and labels (SMP 4) (SMP 6)

2. Solves real-world problems using information in complex picture graphs, circle graphs, line graphs, multiple-line line graphs, bar graphs, and double-bar bar graphs (SMP 4)
3. Explains how showing only part of the scale on the axes of a graph can color the reader's interpretation of the data and identifies examples (SMP 6)
4. Interprets patterns in the data shown in a given *scatter plot*, including clustering, outliers, positive and negative association, linear association, and nonlinear association (8.SP.1) (SMP 7)
5. Explains why straight lines are widely used to model relationships between two quantitative variables (8.SP.2)
6. Fits a straight line informally on data that suggest a linear relationship in a given scatter plot and assesses the fit by judging the closeness of the data points to the line (8.SP.2) (SMP 7)
7. Chooses the linear equation that best approximates the relationship of the data shown in a given scatter plot
8. Constructs scatter plots from real-world data, choosing an appropriate size for intervals and using correct titles and labels (8.SP.1) (SMP 4) (SMP 6)
9. Uses the equation of a linear model to solve problems involving bivariate measurement data, interpreting the slope and the y-intercept (e.g., in a linear model for a biology experiment, interprets 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.3) (SMP 7)
10. Constructs and interprets a two-way table summarizing data on two categorical variables collected from the same subjects and uses relative frequencies to describe possible association between the two variables (e.g., collects data from students on whether they have a curfew and whether they have assigned chores at home to see if there is evidence that students who have a curfew also tend to have chores) (8.SP.4) (SMP 4) (SMP 7)
11. Identifies and explains various sampling techniques that can be used, depending on the situation, including case studies, observations, random sampling, stratified random sampling, representative sampling, systematic sampling, and census
12. Judges the size and representativeness of samples for their adequacy in given situations
13. Distinguishes between valid sampling techniques and invalid sampling techniques (e.g., taking volunteers)
14. Makes analyses of real-world data displayed in frequency tables and charts and draws reasonable conclusions (SMP 1) (SMP 3) (SMP 4) (SMP 7)
15. Chooses to use the mean, median, mode, or range to describe a given set of data and justifies his or her choice (SMP 1)
16. Describes a *bell-shaped curve* and identifies sets of data that should fall into a bell-shaped curve (SMP 6) (SMP 7)
17. Analyzes misleading statistics in actual newspaper, magazine, radio, or television advertisements and news stories (SMP 3)
18. Works cooperatively in a group to design a data-based study: what questions to ask, what data to collect, what data collection methods to use, what sampling techniques and sample size to use, and what graphs and tables to use to report the results (SMP 1) (SMP 4) (SMP 6)

19. Conducts and reports on a group-designed data-based study, using graphs and tables and reporting on measures of central tendency and measures of variation for the data, as appropriate (SMP 3) (SMP 4) (SMP 6)
20. Gives examples of real-world polls, explains the methodology used, explains the meaning of the results, and discusses the probably accuracy of the poll results (e.g., television ratings polls, political polls) (SMP 3)
21. Identifies events in probability problems as *mutually exclusive* or *not mutually exclusive*
22. Recognizes that the sum of the probabilities of all of the mutually exclusive events in a given setting is 1
23. Recognizes that if the probability of an event's occurring is p, then the probability of the event's not occurring is $1–p$
24. Explains the difference between *independent events* and *dependent events* (SMP 6)
25. Calculates the probability in two-event problems when the events are independent and when the events are dependent
26. Solves real-world problems involving permutations and combinations (SMP 4)

Formulas and Their Applications

1. Uses informal arguments to establish that the sum of the interior angles of a triangle is 180° and that the sum of the interior angles of a quadrilateral is 360° (8.G.5a) (SMP 3)
2. Uses informal arguments to establish facts about the measures of exterior angles of triangles (8.G.5b) (SMP 3)
3. Finds missing angle measurements in triangles and quadrilaterals
4. Identifies and defines angles formed when parallel lines are cut by a *transversal* and uses informal arguments to establish facts about them: *interior angles*, *exterior angles*, *alternate interior angles*, *alternate exterior angles*, *consecutive interior angles*, *consecutive exterior angles*, and *corresponding angles* (8.G.5c) (SMP 3) (SMP 6)
5. Uses informal arguments to establish the angle–angle criterion for proving the similarity of triangles (that is, that similar triangles have two pairs of equal corresponding angles) (8.G.5d) (SMP 3)
6. Explains the Pythagorean Theorem in words and with models or pictures: $a^2 + b^2 = c^2$ (in a right triangle, the square of the hypotenuse equals the sum of the squares of the other two sides) (8.G.6) (SMP 2)
7. Explains the converse of the Pythagorean Theorem: if the square of the longest side of a triangle is equal to the sum of the squares of the other two sides, then the triangle is a right triangle (8.G.6)
8. Uses the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions (8.G.7) (SMP 2)
9. Uses the Pythagorean Theorem to find the distance between two points in a coordinate system (8.G.8)
10. Identifies Pythagorean triples (e.g., the 3–4–5 triangle) (SMP 7)
11. Creates scale drawings of two-dimensional shapes
12. Draws three-dimensional geometric solids in two dimensions and labels the dimensions
13. Identifies cross sections that have been cut on a slant

14. Solves mathematical and real-world problems involving the volume of triangular and rectangular pyramids, given the formula $V = 1/3Bh$ (where B is the area of the base) (SMP 2) (SMP 4)
15. Solves mathematical and real-world problems involving the volume of spheres, given the formula $V = 4/3\pi r^3$ (8.G.9) (SMP 2) (SMP 4)
16. Solves mathematical and real-world problems involving the surface area of spheres, given the formula $S = 4\pi r^2$ (SMP 2) (SMP 4)
17. Solves mathematical and real-world problems involving the volume of cylinders, given the formula $V = \pi r^2 h$ (8.G.9) (SMP 2) (SMP 4)
18. Solves mathematical and real-world problems involving the surface area of cylinders, given the formula $S = 2\pi rh + 2\pi r^2$ (SMP 2) (SMP 4)
19. Solves mathematical and real-world problems involving the volume of cones, given the formula $V = 1/3\pi r^2 h$ (8.G.9) (SMP 2) (SMP 4)
20. Solves mathematical and real-world problems involving the surface area of cones, given the formula $S = \pi r^2 + \pi rs$ (SMP 2) (SMP 4)
21. Identifies and defines the *altitude* and *median* of a figure (SMP 6)
22. Identifies and defines an *arc*, *chord*, *central angle*, *sector*, *tangent*, and *secant* of a circle (SMP 6)
23. Uses proportional relationships and properties of corresponding parts of similar triangles and quadrilaterals to find missing measurements
24. Finds the area or volume of figures resulting from adding or subtracting pieces of geometric figures (e.g., the area of a square with a triangle cut out of the middle) (SMP 1) (SMP 7)
25. Identifies symmetry in two-dimensional and three-dimensional figures in the real world, including turning symmetry (e.g., bicycle wheels) and pattern symmetry (e.g., Pascal's triangle)
26. Constructs the perpendicular bisector of a line segment, using a compass and straightedge (SMP 5)
27. Constructs parallel and perpendicular lines, using a compass and straightedge (SMP 5)
28. Bisects an angle, using a compass and straightedge (SMP 5)
29. Appreciates the applications of geometry to art and architecture (SMP 4)
30. Uses scientific notation and units of appropriate size for measuring very small and very large quantities, lengths, distances, areas, weights, and volumes (8.EE.4) (SMP 6)
31. Uses ratios and proportions and similar triangles to measure the height of inaccessible objects (e.g., the roof of a building)
32. Explains the concept of *precision* in measurement (i.e., a stated measure has a related range within which the true measure lies, which is ± one-half the unit of measure) (e.g., a measurement of 12.3 g is in the range of 12.25 and 12.35 g because the unit of measure is tenths of a gram) (SMP 6)
33. Discusses the effect of the precision of measurements on the accuracy of subsequent calculations (SMP 6)
34. Creates procedures for finding solutions to nonstandard measurement problems (SMP 1) (SMP 8)
35. Solves real-world problems by estimating, measuring in, and converting customary units of length (inches, feet, yards, and miles), weight (ounces, pounds, and tons),

and volume (fluid ounces, cups, pints, quarts, and gallons), using appropriate tools (SMP 2) (SMP 4) (SMP 5) (SMP 6)

36. Solves real-world problems by estimating, measuring in, and converting commonly used metric units of length (mm, cm, m, and km), weight (g, kg, and metric tons), and volume (ml and L), using appropriate tools (SMP 2) (SMP 4) (SMP 5) (SMP 6)
37. Appreciates the cultural and practical value of the system of measurement used traditionally by the Iñupiaq people (ILF N.E.s.3.1) (ACS B.1) (ACS D.5)
38. Verifies the properties of transformations (rotations, reflections, and translations) to figures on a coordinate plane, through experimentation (8.G.1)
39. Demonstrates the congruence of two-dimensional figures by applying and describing a sequence of rotations, reflections, and translations (8.G.2)
40. Describes the effects of rotations, reflections, translations, and dilations on two-dimensional figures, using coordinates (8.G.3)
41. Demonstrates the similarity of two-dimensional figures by applying and describing a sequence of rotations, reflections, translations, and dilations (8.G.4)
42. Explains the impact of transformations on measurements of given geometric figures (e.g., the area of a parallelogram, the volume of a cube)
43. Describes three-dimensional shapes as they would appear after undergoing a specified transformation, without actually performing the transformation with a concrete object