

**BEMIDJI AREA SCHOOLS**  
Outcomes in Mathematics – Pre-Algebra

Strand	Standard	No.	Benchmark
Number & Operation	Read, write, compare, classify and represent real numbers, and use them to solve problems in various contexts.	8.1.1.3	Determine rational approximations for solutions to problems involving real numbers.
		8.1.1.4	Know and apply the properties of positive and negative integer exponents to generate equivalent numerical expressions. <i>For example:</i> $3^2 \times 3^{(-5)} = 3^{(-3)} \left(\frac{1}{3}\right)^3 = \frac{1}{27}$ .
		8.1.1.5	Express approximations of very large and very small numbers using scientific notation; understand how calculators display numbers in scientific notation. Multiply and divide numbers expressed in scientific notation, express the answer in scientific notation, using the correct number of significant digits when physical measurements are involved. <i>For example:</i> $(4.2 \times 10^4) \times (8.25 \times 10^3) = 3.465 \times 10^8$ , but if these numbers represent physical measurements, the answer should be expressed as $3.5 \times 10^8$ because the first factor, $4.2 \times 10^4$ , only has two significant digits.
Algebra	Understand the concept of function in real-world and mathematical situations, and distinguish between linear and non-linear functions.	8.2.1.1	Understand that a function is a relationship between an independent variable and a dependent variable in which the value of the independent variable determines the value of the dependent variable. Use functional notation, such as $f(x)$ , to represent such relationships. <i>For example:</i> The relationship between the area of a square and the side length can be expressed as $f(x) = x^2$ . In this case, $f(5) = 25$ , which represents the fact that a square of side length 5 units has area 25 units squared.
		8.2.1.2	Use linear functions to represent relationships in which changing the input variable by some amount leads to a change in the output variable that is a constant times that amount. <i>For example:</i> Uncle Jim gave Emily \$50 on the day she was born and \$25 on each birthday after that. The function $f(x) = 50 + 25x$ represents the amount of money Jim has given after $x$ years. The rate of change is \$25 per year.
	Understand the concept of function in real-world and mathematical situations, and distinguish between linear and non-linear functions.	8.2.1.3	Understand that a function is linear if it can be expressed in the form $f(x) = mx + b$ or if its graph is a straight line. <i>For example:</i> The function $f(x) = x^2$ is not a linear function because its graph contains the points (1,1), (-1,1) and (0,0), which are not on a straight line.

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Algebra	Recognize linear functions in real-world and mathematical situations; represent linear functions and other functions with tables, verbal descriptions, symbols and graphs; solve problems involving these functions and explain results in the original context.	8.2.2.1	Represent linear functions with tables, verbal descriptions, symbols, equations and graphs; translate from one representation to another.
		8.2.2.2	Identify graphical properties of linear functions including slopes and intercepts. Know that the slope equals the rate of change, and that the y-intercept is zero when the function represents a proportional relationship.
		8.2.2.3	Identify how coefficient changes in the equation $f(x) = mx + b$ affect the graphs of linear functions. Know how to use graphing technology to examine these effects.
	Generate equivalent numerical and algebraic expressions and use algebraic properties to evaluate expressions.	8.2.3.1	Evaluate algebraic expressions, including expressions containing radicals and absolute values, at specified values of their variables. <i>For example:</i> Evaluate $\pi r^2 h$ when $r = 3$ and $h = 0.5$ , and then use an approximation of $\pi$ , to obtain an approximate answer.
		8.2.3.2	Justify steps in generating equivalent expressions by identifying the properties used, including the properties of algebra. Properties include the associative, commutative and distributive laws, and the order of operations, including grouping symbols.
	Represent real-world and mathematical situations using equations and inequalities involving linear expressions. Solve equations and inequalities symbolically and graphically. Interpret solutions in the original context.	8.2.4.1	Use linear equations to represent situations involving a constant rate of change, including proportional and non-proportional relationships. <i>For example:</i> For a cylinder with fixed radius of length 5, the surface area $A = 2\pi(5)h + 2\pi(5)^2 = 10\pi h + 50\pi$ , is a linear function of the height $h$ , but it is not proportional to the height.
		8.2.4.2	Solve multi-step equations in one variable. Solve for one variable in a multi-variable equation in terms of the other variables. Justify the steps by identifying the properties of equalities used. <i>For example:</i> The equation $10x + 17 = 3x$ can be changed to $7x + 17 = 0$ , and then to $7x = -17$ by adding/subtracting the same quantities to both sides. These changes do not change the solution of the equation. <i>Another example:</i> Express the radius of a circle in terms of its circumference.
		8.2.4.3	Express linear equations in slope-intercept, point-slope and standard forms, and convert between these forms. Given sufficient information, find an equation of a line. <i>For example:</i> Determine an equation of the line through the points $(-1,6)$ and $(2/3, -3/4)$ .
		8.2.4.4	Use linear inequalities to represent relationships in various contexts. <i>For example:</i> A gas station charges \$0.10 less per gallon of gasoline if a customer also gets a car wash. Without the car wash, gas costs \$2.79 per gallon. The car wash is \$8.95. What are the possible amounts (in gallons) of gasoline that you can buy if you also get a car wash and can spend at most \$35?
		8.2.4.5	Solve linear inequalities using properties of inequalities. Graph the solutions on a number line. <i>For example:</i> The inequality $-3x < 6$ is equivalent to $x > -2$ , which can be represented on the number line by shading in the interval to the right of $-2$ .

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Algebra	Represent real-world and mathematical situations using equations and inequalities involving linear expressions. Solve equations and inequalities symbolically and graphically. Interpret solutions in the original context.	8.2.4.6	<p>Represent relationships in various contexts with equations and inequalities involving the absolute value of a linear expression. Solve such equations and inequalities and graph the solutions on a number line.</p> <p><i>For example:</i> A cylindrical machine part is manufactured with a radius of 2.1 cm, with a tolerance of 1/100 cm. The radius <math>r</math> satisfies the inequality <math> r - 2.1  \leq .01</math>.</p>
		8.2.4.7	<p>Represent relationships in various contexts using systems of linear equations. Solve systems of linear equations in two variables symbolically, graphically and numerically.</p> <p><i>For example:</i> Marty's cell phone company charges \$15 per month plus \$0.04 per minute for each call. Jeannine's company charges \$0.25 per minute. Use a system of equations to determine the advantages of each plan based on the number of minutes used.</p>
		8.2.4.8	<p>Understand that a system of linear equations may have no solution, one solution, or an infinite number of solutions. Relate the number of solutions to pairs of lines that are intersecting, parallel or identical. Check whether a pair of numbers satisfies a system of two linear equations in two unknowns by substituting the numbers into both equations.</p>
Algebra	Understand the concept of function, and identify important features of functions and other relations using symbolic and graphical methods.	9.2.1.1	<p>Understand the definition of a function. Use functional notation and evaluate a function at a given point in its domain.</p> <p><i>For example:</i> If <math>f(x) = \frac{1}{x^2 - 3}</math>, find <math>f(-4)</math>.</p>
		9.2.1.2	Distinguish between functions and other relations defined symbolically, graphically or in tabular form.
		9.2.1.3	<p>Find the domain of a function defined symbolically, graphically or in a real-world context.</p> <p><i>For example:</i> The formula <math>f(x) = \pi x^2</math> can represent a function whose domain is all real numbers, but in the context of the area of a circle, the domain would be restricted to positive <math>x</math>.</p>