BEMIDJI AREA SCHOOLS

Outcomes in Mathematics – Algebra IA

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. *For example*: A calculator can be used to determine that $\sqrt{7}$ is approximately 2.65. *Another example*: To check that $1\frac{5}{12}$ is slightly bigger than $\sqrt{2}$, do the calculation $\left(1\frac{5}{12}\right)^2=\left(\frac{17}{12}\right)^2=\frac{289}{144}=2\frac{1}{144}$. *Another example*: Knowing that $\sqrt{10}$ is between 3 and 4, try squaring numbers like 3.5, 3.3, 3.1 to determine that 3.1 is a reasonable rational approximation of $\sqrt{10}$.
		8.1.1.4	Know and apply the properties of positive and negative integer exponents to generate equivalent numerical expressions. *For example*: $3^2\times 3^{(-5)}=3^{(-3)}\left(\frac{1}{3}\right)^3=\frac{1}{27}$.
		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. *For example*: $(4.2\times10^4)\times(8.25\times10^3)=3.465\times10^8$, but if these numbers represent physical measurements, the answer should be expressed as 3.5×10^8 because the first factor, 4.2×10^4 , 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. 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. *For example*: 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. *For example*: 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.
		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. *For example*: 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.
		8.2.1.4	Understand that an arithmetic sequence is a linear function that can be expressed in the form $f(x)=mx+b$, where $x = 0, 1, 2, 3,\ldots$. *For example*: The arithmetic sequence 3, 7, 11, 15, …, can be expressed as $f(x) = 4x + 3$.
		8.2.1.5	Understand that a geometric sequence is a non-linear function that can be expressed in the form $f(x)=ab^x$, where $x = 0, 1, 2, 3,\ldots$. *For example*: The geometric sequence 6, 12, 24, 48, … , can be expressed in the form $f(x) = 6(2^x)$.

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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.
		8.2.2.4	Represent arithmetic sequences using equations, tables, graphs and verbal descriptions, and use them to solve problems. *For example*: If a girl starts with $100 in savings and adds $10 at the end of each month, she will have $100 + 10x$ dollars after x months.
		8.2.2.5	Represent geometric sequences using equations, tables, graphs and verbal descriptions, and use them to solve problems. *For example*: If a girl invests $100 at 10% annual interest, she will have $100(1.1^x)$ dollars after x years.

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Algebra	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. *For example*: Evaluate $\pi r^2 h$ when $r = 3$ and $h = 0.5$, and then use an approximation of π, 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. *For example*: 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. *For example*: 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. *Another example*: 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. *For example*: 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. *For example*: 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. *For example*: 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	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. *For example*: A cylindrical machine part is manufactured with a radius of 2.1 cm, with a tolerance of 1/100 cm. The radius r satisfies the inequality $\lvert r - 2.1\rvert \leq .01$.
		8.2.4.7	Represent relationships in various contexts using systems of linear equations. Solve systems of linear equations in two variables symbolically, graphically and numerically. *For example*: 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.
		8.2.4.8	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.
	Solve problems involving parallel and perpendicular lines on a coordinate system.	8.3.2.1	Understand and apply the relationships between the slopes of parallel lines and between the slopes of perpendicular lines. Dynamic graphing software may be used to examine the relationships between lines and their equations.
Data Analysis & Probability	Interpret data using scatterplots and approximate lines of best fit. Use lines of best fit to draw conclusions about data.	8.4.1.1	Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit and determine an equation for the line. Use appropriate titles, labels and units. Know how to use graphing technology to display scatterplots and corresponding lines of best fit.
		8.4.1.2	Use a line of best fit to make statements about approximate rate of change and to make predictions about values not in the original data set. *For example*: Given a scatterplot relating student heights to shoe sizes, predict the shoe size of a 5'4" student, even if the data does not contain information for a student of that height.
		8.4.1.3	Assess the reasonableness of predictions using scatterplots by interpreting them in the original context. *For example*: A set of data may show that the number of women in the U.S. Senate is growing at a certain rate each election cycle. Is it reasonable to use this trend to predict the year in which the Senate will eventually include 1000 female Senators?

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Algebra	Understand the concept of function, and identify important features of functions and other relations using symbolic and graphical methods.	9.2.1.1	Understand the definition of a function. Use functional notation and evaluate a function at a given point in its domain. *For example*: If $f(x)=\frac{1}{x^2-3}$, find $f(-4)$.
		9.2.1.2	Distinguish between functions and other relations defined symbolically, graphically or in tabular form.
		9.2.1.3	Find the domain of a function defined symbolically, graphically or in a real-world context. *For example*: The formula $f(x) = \pi x^2$ 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 x.
		9.2.1.8	Make qualitative statements about the rate of change of a function, based on its graph or table of values. *For example*: The function $f(x) = 3^x$ increases for all x, but it increases faster when $x > 2$ than it does when $x < 2$.
		9.2.1.9	Determine how translations affect the symbolic and graphical forms of a function. Know how to use graphing technology to examine translations. *For example*: Determine how the graph of $f(x) = \|x – h\| + k$ changes as h and k change.
	Recognize linear, quadratic, exponential and other common functions in real-world and mathematical situations; represent these functions with tables, verbal descriptions, symbols and graphs; solve problems involving these functions, and explain results in the original context.	9.2.2.5	Recognize and solve problems that can be modeled using finite geometric sequences and series, such as home mortgage and other compound interest examples. Know how to use spreadsheets and calculators to explore geometric sequences and series in various contexts.

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Strand	Standard	No.	Benchmark
Algebra	Represent real-world and mathematical situations using equations and inequalities involving linear, quadratic, exponential and nth root functions. Solve equations and inequalities symbolically and graphically. Interpret solutions in the original context.	9.2.4.4	Represent relationships in various contexts using systems of linear inequalities; solve them graphically. Indicate which parts of the boundary are included in and excluded from the solution set using solid and dotted lines.
Geometry & Measurement	Calculate measurements of plane and solid geometric figures; know that physical measurements depend on the choice of a unit and that they are approximations.	9.3.1.3	Understand that quantities associated with physical measurements must be assigned units; apply such units correctly in expressions, equations and problem solutions that involve measurements; and convert between measurement systems. *For example*: 60 miles/hour = 60 miles/hour × 5280 feet/mile × 1 hour/3600 seconds = 88 feet/second.
Data Analysis & Probability	Display and analyze data; use various measures associated with data to draw conclusions, identify trends and describe relationships.	9.4.1.3	Use scatterplots to analyze patterns and describe relationships between two variables. Using technology, determine regression lines (line of best fit) and correlation coefficients; use regression lines to make predictions and correlation coefficients to assess the reliability of those predictions.