Bemidji Area Schools
Outcomes in Mathematics – Algebra 2B

	Strand	Standard	No.	Benchmark
9, 10, 11	Algebra	Understand the concept of function, and identify important features of functions and other relations using symbolic and graphical methods where appropriate.	9.2.1.6	Identify intercepts, zeros, maxima, minima and intervals of increase and decrease from the graph of a function.
			9.2.1.7	Understand the concept of an asymptote and identify asymptotes for exponential functions and reciprocals of linear functions, using symbolic and graphical methods.
			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.	9.2.2.1	Represent and solve problems in various contexts using linear and quadratic functions. *For example*: Write a function that represents the area of a rectangular garden that can be surrounded with 32 feet of fencing, and use the function to determine the possible dimensions of such a garden if the area must be at least 50 square feet.
			9.2.2.2	Represent and solve problems in various contexts using exponential functions, such as investment growth, depreciation and population growth.
			9.2.2.3	Sketch graphs of linear, quadratic and exponential functions, and translate between graphs, tables and symbolic representations. Know how to use graphing technology to graph these functions.

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9, 10, 11	Algebra	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.	9.2.2.4	Express the terms in a geometric sequence recursively and by giving an explicit (closed form) formula, and express the partial sums of a geometric series recursively. *For example*: A closed form formula for the terms t_n in the geometric sequence 3, 6, 12, 24, ... is $t_n = 3(2)^{n-1}$, where $n = 1, 2, 3, \ldots$, and this sequence can be expressed recursively by writing $t_1 = 3$ and $t_n = 2t_{n-1}$, for $n \geq 2$. *Another example*: the partial sums s_n of the series $3 + 6 + 12 + 24 + \ldots$ can be expressed recursively by writing $s_1 = 3$ and $s_n = 3 + 2s_{n-1}$, for $n \geq 2$.
			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.
			9.2.2.6	Sketch the graphs of common non-linear functions such as $f(x)=\sqrt{x}$, $f(x)=\lvert x\rvert$, $f(x)=\frac{1}{x}$, $f(x) = x^3$, and translations of these functions, such as $f\left(x\right)=\sqrt{x-2}+4$. Know how to use graphing technology to graph these functions.
		Generate equivalent algebraic expressions involving polynomials and radicals; use algebraic properties to evaluate expressions.	9.2.3.1	Evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified points in their domains.
			9.2.3.4	Add, subtract, multiply, divide and simplify algebraic fractions. *For example*: $\frac{1}{1-x}+\frac{x}{1+x}$ is equivalent to $\frac{1+2x-x^2}{1-x^2}$.
			9.2.3.6	Apply the properties of positive and negative rational exponents to generate equivalent algebraic expressions, including those involving n^{th} roots. *For example*: $\sqrt{2}\times\sqrt{7}=2^{\frac{1}{2}}\times7^{\frac{1}{2}}=14^{\frac{1}{2}}=\sqrt{14}$. Rules for computing directly with radicals may also be used: $\sqrt{2}\times\sqrt{x}=\sqrt{2x}$.
			9.2.3.7	Justify steps in generating equivalent expressions by identifying the properties used. Use substitution to check the equality of expressions for some particular values of the variables; recognize that checking with substitution does not guarantee equality of expressions for all values of the variables.

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9, 10, 11	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.	9.2.4.1	Represent relationships in various contexts using quadratic equations and inequalities. Solve quadratic equations and inequalities by appropriate methods including factoring, completing the square, graphing and the quadratic formula. Find non-real complex roots when they exist. Recognize that a particular solution may not be applicable in the original context. Know how to use calculators, graphing utilities or other technology to solve quadratic equations and inequalities. *For example*: A diver jumps from a 20 meter platform with an upward velocity of 3 meters per second. In finding the time at which the diver hits the surface of the water, the resulting quadratic equation has a positive and a negative solution. The negative solution should be discarded because of the context.
			9.2.4.2	Represent relationships in various contexts using equations involving exponential functions; solve these equations graphically or numerically. Know how to use calculators, graphing utilities or other technology to solve these equations.
			9.2.4.8	Assess the reasonableness of a solution in its given context and compare the solution to appropriate graphical or numerical estimates; interpret a solution in the original context.
	Data Analysis & Probability	Display and analyze data; use various measures associated with data to draw conclusions, identify trends and describe relationships.	9.4.1.4	Use the mean and standard deviation of a data set to fit it to a normal distribution (bell-shaped curve) and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets and tables to estimate areas under the normal curve. *For example*: After performing several measurements of some attribute of an irregular physical object, it is appropriate to fit the data to a normal distribution and draw conclusions about measurement error. *Another example*: When data involving two very different populations is combined, the resulting histogram may show two distinct peaks, and fitting the data to a normal distribution is not appropriate.

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9, 10, 11	Data Analysis & Probability	Explain the uses of data and statistical thinking to draw inferences, make predictions and justify conclusions.	9.4.2.1	Evaluate reports based on data published in the media by identifying the source of the data, the design of the study, and the way the data are analyzed and displayed. Show how graphs and data can be distorted to support different points of view. Know how to use spreadsheet tables and graphs or graphing technology to recognize and analyze distortions in data displays. *For example*: Shifting data on the vertical axis can make relative changes appear deceptively large.
			9.4.2.2	Identify and explain misleading uses of data; recognize when arguments based on data confuse correlation and causation.
			9.4.2.3	Explain the impact of sampling methods, bias and the phrasing of questions asked during data collection.
		Calculate probabilities and apply probability concepts to solve real-world and mathematical problems.	9.4.3.1	Select and apply counting procedures, such as the multiplication and addition principles and tree diagrams, to determine the size of a sample space (the number of possible outcomes) and to calculate probabilities. *For example*: If one girl and one boy are picked at random from a class with 20 girls and 15 boys, there are $20 \times 15 = 300$ different possibilities, so the probability that a particular girl is chosen together with a particular boy is $\frac{1}{300}$.
			9.4.3.2	Calculate experimental probabilities by performing simulations or experiments involving a probability model and using relative frequencies of outcomes.
			9.4.3.3	Understand that the Law of Large Numbers expresses a relationship between the probabilities in a probability model and the experimental probabilities found by performing simulations or experiments involving the model.
			9.4.3.4	Use random numbers generated by a calculator or a spreadsheet, or taken from a table, to perform probability simulations and to introduce fairness into decision making. *For example*: If a group of students needs to fairly select one of its members to lead a discussion, they can use a random number to determine the selection.
			9.4.3.5	Apply probability concepts such as intersections, unions and complements of events, and conditional probability and independence, to calculate probabilities and solve problems. *For example*: The probability of tossing at least one head when flipping a fair coin three times can be calculated by looking at the complement of this event (flipping three tails in a row).

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9, 10, 11	Data Analysis & Probability	Calculate probabilities and apply probability concepts to solve real-world and mathematical problems.	9.4.3.6	Describe the concepts of intersections, unions and complements using Venn diagrams. Understand the relationships between these concepts and the words AND, OR, NOT, as used in computerized searches and spreadsheets.
			9.4.3.7	Understand and use simple probability formulas involving intersections, unions and complements of events. *For example*: If the probability of an event is *p*, then the probability of the complement of an event is 1 – *p*; the probability of the intersection of two independent events is the product of their probabilities. *Another example*: The probability of the union of two events equals the sum of the probabilities of the two individual events minus the probability of the intersection of the events.
			9.4.3.8	Apply probability concepts to real-world situations to make informed decisions. *For example*: Explain why a hockey coach might decide near the end of the game to pull the goalie to add another forward position player if the team is behind. *Another example*: Consider the role that probabilities play in health care decisions, such as deciding between having eye surgery and wearing glasses.
			9.4.3.9	Use the relationship between conditional probabilities and relative frequencies in contingency tables. *For example*: A table that displays percentages relating gender (male or female) and handedness (right-handed or left-handed) can be used to determine the conditional probability of being left-handed, given that the gender is male.