Identifier	Poplar - Grade 9 - Mathematics		Introduced	Completed
9 M 1	**MATHEMATICAL PRACTICES**			
9 M 1.1.01	Makes sense of problems and persevere in solving them.			
9 M 1.1.02	Reason abstractly and quantitatively.			
9 M 1.1.03	Construct viable arguments and critique the resoning of others.			
9 M 1.1.04	Model with mathematics.			
9 M 1.1.05	Use appropriate tools strategically.			
9 M 1.1.06	Attend to precision.			
9 M 1.1.07	Look for and muke use of structure.			
9 M 1.1.08	Look for and express regularity in repeated reasoning.			
9 M 2	**NUMBER AND QUANTITY**			
9 M 2.1.01	The Real Number System	Explain how the definition of the meaing of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radical in terms of ration exponents.		
9 M 2.1.02	The Real Number System	Rewrite expressions involving radicals and rational exponents using the properties of exponents.		
9 M 2.1.03	The Real Number System	Explain why the sum or product of two rational numbers is rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.		
9 M 2.2.01	Quantities	Use units as a way to understand problems from a variety of contexts (e.g., science, history, and culture), including those of Montana American Indians, and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.		
9 M 2.2.02	Quantities	Define appropriate quantities for the purpose of descriptive modeling.		
9 M 2.2.03	Quantities	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.		
9 M 2.3.01	The Complex Number System	Know there is a complex number I such that i2 = -1, and every complex number has the form a + bi with a and b real.		
9 M 2.3.02	The Complex Number System	Use the relation i2 = -1 and the commutattive, associative, and distributive properties to add, subtract, and multiply complex numbers.		
9 M 2.3.03	The Complex Number System	Find the conjugate of a complex number; use conjugates to find mouli and quotients of complex numbers.		
9 M 2.3.04	The Complex Number System	Represent complex numbers on the complex plane		
9 M 2.3.05	The Complex Number System	Represent addition, subtraction , multiplication, and conjugation of complex numbers geometrically on the complex plane		
9 M 2.3.06	The Complex Number System	Calculate the distance between numbers in the complex plane as the modulus of the difference		
9 M 2.3.07	The Complex Number System	Solve quadratic equations with real coefficients that have complex solutions.		
9 M 2.3.08	The Complex Number System	Extend polynomial identities to the complex numbers.		
9 M 2.3.09	The Complex Number System	Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.		
9 M 2.4.01	Vector and Matrix Quantities	Recognize vector quantities as having both magnitude and direction.		
9 M 2.4.02	Vector and Matrix Quantities	Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.		
9 M 2.4.03	Vector and Matrix Quantities	Solve problems from a variety of contexts (e.g., science, history, and culture), including those of Montana American Indians, involving velocity and other quantities that can be represented by vectors.		
9 M 2.4.04	Vector and Matrix Quantities	Add and subtract vectors		
9 M 2.4.05	Vector and Matrix Quantities	Multiply a vector by a scalar		
9 M 2.4.06	Vector and Matrix Quantities	Use matrices to represent and manipulate data		
9 M 2.4.07	Vector and Matrix Quantities	Multiply matrices by scalars to produce new matrices		
9 M 2.4.08	Vector and Matrix Quantities	Add, subract, and multiply matrices of appropriate dimensions.		
9 M 2.4.09	Vector and Matrix Quantities	Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation		
9 M 2.4.10	Vector and Matrix Quantities	Understand that the zero and identity matrices play a role in matrix addition and multiplication		
9 M 2.4.11	Vector and Matrix Quantities	Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector.		
9 M 2.4.12	Vector and Matrix Quantities	Work with 2x2 matrices as a transformation of the plane, and interpret the absolute value of the determinant in terms of area.		
9 M 3	**ALGEBRA**			
9 M 3.1.01	Seeing Structure in Expressions	Interpret expression that represent a quantity in terms of its context		
9 M 3.1.02	Seeing Structure in Expressions	Interpret parts of an expression, such as terms, factors, and coefficients		
9 M 3.1.03	Seeing Structure in Expressions	Interpret complicated expressions by viewing one or more of their parts as a single entity.		
9 M 3.1.04	Seeing Structure in Expressions	Use the structure of an expression to identify ways to rewrite it.		
9 M 3.1.05	Seeing Structure in Expressions	Choose and produce an equivalent form of an expression to real and explain properties of the quantity represented by the expression		
9 M 3.1.06	Seeing Structure in Expressions	Factor a quadratic expression to reveal the zeros of the function it defines		
9 M 3.1.07	Seeing Structure in Expressions	Complete the square in a quadratic expression to reveal the maximum and minimum value of the function it defines		
9 M 3.1.08	Seeing Structure in Expressions	Use the properties of exponents to transform expressions for exponential functions		
9 M 3.1.09	Seeing Structure in Expressions	Derive the formula for the sum of a finite geometric serios (when the common ratio is not 1), and use the formula to solve problems.		

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9 M 3.2.01	Arithmetic with Polynomials and Rational Expressions	Understand that polynomilas form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.		
9 M 3.2.02	Arithmetic with Polynomials and Rational Expressions	Know and apply the Remainder Theorem. For a polynomial $p(x)$ and a number a, the remainder on division by $x-a$ is $p(a)$, so $p(a)=0$ if and only if $(x-a)$ is a factor of $p(x)$.		
9 M 3.2.03	Arithmetic with Polynomials and Rational Expressions	Identify zeros of polynomials when suitable facotrization are available, and use the zeros to construct a rough graph of the function defined by the polynomial.		
9 M 3.2.04	Arithmetic with Polynomials and Rational Expressions	Prove polynomial identities and use them to describe numerical relationships.		
9 M 3.2.05	Arithmetic with Polynomials and Rational Expressions	Know and apply the Binomial Theorem for the expansion of (x + y)n in powers of x and y for a positvie integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.		
9 M 3.2.06	Arithmetic with Polynomials and Rational Expressions	Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or for the more complicated examples, a computer algebra system.		
9 M 3.2.07	Arithmetic with Polynomials and Rational Expressions	Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.		
9 M 3.3.01	Creating Equations	Create equations and inequalities in one variable and use them to solve provlems from a variety of contexts (e.g., science, history, and culture), including those of MT American Indians.		
9 M 3.3.02	Creating Equations	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.		
9 M 3.3.03	Creating Equations	Represent constraints by equations or inequalities, and by systems of equations and/or inequalites, and interpret solutions as viable or nonviable options in a modeling context.		
9 M 3.3.04	Creating Equations	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.		
9 M 3.4.01	Reasoning with Equations and Inequalities	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting rom the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.		
9 M 3.4.02	Reasoning with Equations and Inequalities	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.		
9 M 3.4.03	Reasoning with Equations and Inequalities	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.		
9 M 3.4.04	Reasoning with Equations and Inequalities	Solve quadratic equations in one variable.		
9 M 3.4.05	Reasoning with Equations and Inequalities	Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x-p)2 = q that has the same solutions. Derive the quadratic formula from this form.		
9 M 3.4.06	Reasoning with Equations and Inequalities	Solve quadratic equations by inspection, taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solultions and write them as $a +/ b$ i for real numbers a and b.		
9 M 3.4.07	Reasoning with Equations and Inequalities	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.		
9 M 3.4.08	Reasoning with Equations and Inequalities	Solve systems of linear equations exactly and approximately (e.g. with graphs), focusing on pairs of linear equations in two variables.		
9 M 3.4.09	Reasoning with Equations and Inequalities	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.		
9 M 3.4.10	Reasoning with Equations and Inequalities	Represent a system of linear equations as a single matrix equation in a vector variable.		
9 M 3.4.11	Reasoning with Equations and Inequalities	Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimensions 3x3 or greater).		
9 M 3.4.12	Reasoning with Equations and Inequalities	Understand that the graph of an equation in two variables is set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).		
9 M 3.4.13	Reasoning with Equations and Inequalities	Explain why the x-coordinates of the points where the graphs of the equations $y=f(x)$ and $y=g(x)$ intersect are the solutions of the equation $f(x)=g(x)$; find the solutions approximately, e.g. using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponenetial, and logarithmic functions.		
9 M 3.4.14	Reasoning with Equations and Inequalities	Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes		
9 M 4	**FUNCTIONS**			
9 M 4.1.01	Interpreting Functions	Understand the concept of a function and use function notation		
9 M 4.1.02	Interpreting Functions	Interpret functions that arise in applications in terms of the context		
9 M 4.1.03	Interpreting Functions	Analyze functions using different representations		
9 M 4.2.01	Building Functions	Build a function that models a relationship between two quantities		
9 M 4.2.02	Building Functions	Build new functions from existing functions		
9 M 4.3.01	Linear, Quadratic, and Exponential Models	Construct and compare linear, quadratic, and exponential models and solve problems		
9 M 4.3.02	Linear, Quadratic, and Exponential Models	Interpret expressions for functions in terms of the situation they model		

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9 M 4.4.01	Trigonometric Functions	Extend the domain of trigonometric functions using the unit circle		
9 M 4.4.02	Trigonometric Functions	Model periodic phenomena with trigonometric functions		
9 M 4.4.03	Trigonometric Functions	Prove and apply trigonometric identities		
9 M 5	**GEOMETRY**			
9 M 5.1.01	Congruence	Experiment with transformations in the plane		
9 M 5.1.02	Congruence	Understand congruence in terms of rigid motions		
9 M 5.1.03	Congruence	Prove geometric theorems		
9 M 5.1.04	Congruence	Make geometric constructions		
9 M 5.2.01	Similarity, Right Triangles, and Trigonometry	Understand similarity in terms of similarity transformations		
9 M 5.2.02	Similarity, Right Triangles, and Trigonometry	Prove theorems involving similarity		
9 M 5.2.03	Similarity, Right Triangles, and Trigonometry	Define trigonometric ratios and solve problems involving right triangles		
9 M 5.2.04	Similarity, Right Triangles, and Trigonometry	Apply trigonometry to general triangles		
9 M 5.3.01	Circles	Understand and apply theorems about circles		
9 M 5.3.02	Circles	Find arc lengths and areas of sectors of circles		
9 M 5.4.01	Expressing Geometric Properties with Equations	Translate between the geometric description and the equation for a conic section		
9 M 5.4.02	Expressing Geometric Properties with Equations	Use coordinates to prove simple geometric theorems algebraically		
9 M 5.5.01	Geometric Measurement and Dimension	Explain volume formulas and use them to solve problems		
9 M 5.5.02	Geometric Measurement and Dimension	Visualize relationships between two-dimensional and three-dimensional objects		
9 M 5.6.01	Modeling with Geometry	Apply geometric concepts in modeling situations		
9 M 6	**STATISTICS AND PROBABILITY**			
9 M 6.1.01	Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on a single count or measurement variable		
9 M 6.1.02	Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on two categorical and quantitative variables		
9 M 6.1.03	Interpreting Categorical and Quantitative Data	Interpret linear models		
9 M 6.2.01	Making Inferences and Justifying Conclusions	Understand and evaluate random processes underlying statistical experiments		
9 M 6.2.02	Making Inferences and Justifying Conclusions	Make inferences and justify conclusions from sample surveys, experiments and observational studies		
9 M 6.3.01	Conditional Probability and the Rules of Probability	Understand independence and conditional probability and use them to interpret data		
9 M 6.3.02	Conditional Probability and the Rules of Probability	Use the rules of probability to compute probabilities of compound events in a uniform probability model		
9 M 6.4.01	Using Probability to Make Decisions	Calculate expected values and use them to solve problems		
9 M 6.4.02	Using Probability to Make Decisions	Use probability to evaluate outcomes of decisions		