Grade 8 – Expressions and Equations

Essential Questions:

1. How do you use patterns to understand mathematics and model situations?
2. What is algebra?
3. How are the horizontal and vertical axes related?
4. How do algebraic representations relate and compare to one another?
5. How can we communicate and generalize algebraic relationships?

Essential Vocabulary – integer, exponents, equivalent, expression, base, power, property, irrational, rational, square root (length of the side of a square), cube root (length of a side of a cube), inverse operation, scientific notation, quantities, magnitude, scientific notation, decimal notation, unit rate, slope, graph, table, equation, proportional relationships, similar triangles, slope, non-vertical line, coordinate plane, origin, y-axis (vertical axis), linear equation, variable, solution, distributive property, collecting like terms, coefficient, system of linear equations, solution to a system, ordered pair,point of intersection, parallel, slope, y-intercept

8.EE.1.: Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. properties, integer exponents, equivalent numerical expressions	1. use numerical bases and the laws of exponents	1. Know properties of integer exponents 2. Apply properties of integer exponents 3. Generate equivalent numerical expressions

8.EE.2.–: Use 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. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Square root symbol, cube root symbol, solutions, perfect squares, perfect cubes	1. That squaring and taking the square root of a number are inverse operations, likewise with cubing and cube root, and use to solve equations. 2. That non-perfect squares and non-perfect cubes are irrational	1. use root symbols to represent solutions where p is a positive rational number 2. evaluate square and cube roots 3. recognize perfect squares and perfect cubes

8.EE.3.: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. scientific notation	1. that if the exponent increases by 1, the value increases 10 times	1. express numbers in scientific notation 2. compare and interpret scientific notation quantities in the context of the situation

8.EE.4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. scientific notation, decimal notation	1. scientific notation as generated on various calculators or other technology	1. use laws of exponents to perform operations with numbers written in scientific notation

8.EE.5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. proportional relationships, unit rate, slope	1. that the unit rate, or the slope, can be represented in a graph, table or equation.	1. graph proportional relationships 2. interpret the unit rate as the slope 3. compare two different proportional relationships represented in different ways

8.EE.6: Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive 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.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Slope, y=mx and y=mx+b	1. that you can derive the slope from any two	1. use similar triangles to determine slope

	distinct points 2. that y=mx will go through the origin and y=mx+b does not 3. that m represents the slope	2. derive the equation y=mx and y=mx+b
8.EE.7: Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the 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). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.		
Grade 8 Enduring Understandings		
Students will know… 1. linear equations, one solution, infinitely many solutions, no solution	***Students will understand…*** 1. the solution to an equation is the value(s) of the variable which makes the equation true 2. with one solution the variables do not cancel out and only one value makes the equation true 3. with no solution the variables cancel out and constants are not equal, no real number makes the equation true 4. with infinite solutions the variables cancel and constants are equal, any real number makes the equation true	***Students will be able to…*** 1. solve linear equations using distributive property and combine like terms 2. determine if an equation has one solution, infinitely many solutions or no solution
8.EE.8: Analyze and solve pairs of simultaneous linear equations. a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6. c. Solve real-world and mathematical problems from a variety of cultural contexts, including those of Montana American Indians, leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of*		

points intersects the line through the second pair.		
Grade 8 Enduring Understandings		
Students will know… 1. Systems of linear equations	***Students will understand…*** 1. that a solution to a system of linear equations is an ordered pair that satisfies both equations 2. that graphed lines with one point of intersection (different slopes) will have one solution 3. that parallel lines (same slope, different y-intercept) have no solution 4. that lines that are the same (same slope, same y-intercept) have infinitely many solutions	***Students will be able to…*** 1. solve systems graphically and algebraically 2. solve real-world and mathematical problems

Grade 8 - Functions

Essential Questions:

6. How do you use patterns to understand mathematics and model situations?
7. What is algebra?
8. How are the horizontal and vertical axes related?
9. How do algebraic representations relate and compare to one another?
10. How can we communicate and generalize algebraic relationships?

Essential Vocabulary – Function, input, output, ordered pair, equation, graph, table of values, linear, non-linear, equations, rate of change, initial value, function, quantities, ordered pair, y-intercept, slope, equations, graph, graph, model

8.F.1: Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.1

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. functions, inputs, outputs, ordered pairs, function graphs	1. that a function is a rule that assigns one input to exactly one output.	1. identify functions and non-functions using equations tables and graphs

8.F.2: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. linear equations, graphs, table of values, and verbal descriptions	1. that functions can be represented in many different forms	1. compare functions from different representations

8.F.3: Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. y = mx + b, strait line, non-linear	1. that y = mx+b defines a linear equation	1. categorize functions as linear or non-linear

8.F.4: Construct a function to model a linear relationship between two quantities. Determine 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. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.		
Grade 8 Enduring Understandings		
Students will know… 1. rate of change, initial value, function, quantities, table, ordered pairs	***Students will understand…*** 1. that initial value and rate of change can be found from multiple representation	***Students will be able to…*** 1. Construct a function to model a linear situation 2. Determine the rate of change and initial value from tables, graphs, equations, or verbal descriptions
8.F.5: Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.		
Grade 8 Enduring Understandings		
Students will know… 1. function, graph, verbal description, model	***Students will understand…*** 1. how graphs can be used as a model for situations	***Students will be able to…*** 1. sketch a graph to model given a verbal description of a situation 2. give a verbal description given a graph of a situation

Grade 8 – Geometry

Essential Questions:

1. Why are geometry and geometric figures relevant and important?
2. How can geometric ideas be communicated using a variety of representations?

******(i.e maps, grids, charts, spreadsheets)

3. How can geometry be used to solve problems about real-world situations, spatial relationships, and logical reasoning?

Essential Vocabulary – rotation, reflection, translation, line, line segment, angle, parallel lines, congruent, similar, corresponding, protractor, translation, dilation, congruent, similar, interior and exterior angles, vertical angles, supplementary angles, complementary angles, similar triangles, congruent, transversal, parallel, right triangle, legs, hypotenuse, square, Pythagorean theorem, converse, ordered pair, distance, horizontal, vertical, x-axis, y-axis, x-coordinate, y-coordinate, Base area, height, radius, pi, volume

8.G.1: Verify experimentally the properties of rotations, reflections, and translations from a variety of cultural contexts, including those of Montana American Indians::
a. Lines are taken to lines, and line segments to line segments of the same length.
b. Angles are taken to angles of the same measure.
c. Parallel lines are taken to parallel lines.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Transformations for a variety of shapes and figures	1. Congruence 2. Similarity	1. Rotate, reflect and translate figures 2. Use a cultural context for translating figures 3. Measure to establish congruency 4. Find corresponding sides and angles

8.G.2: Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Translations to establish congruency	1. Congruence 2. Similarity	1. Translate, Rotate, and Reflect figures 2. Describe the steps to derive one figure from another.

8.G.3: Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures from a variety of cultural contexts, including those of Montana American Indians, using coordinates.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. dilations, translations, rotations, reflections, coordinate mapping	1. transformations 2. coordinate graphing 3. congruence 4. similarity	1. Use cultural contexts to describe transformations 2. Use coordinates to describe the location of transformations

8.G.4: Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two dimensional figures, describe a sequence that exhibits the similarity between them.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Translations to establish similarity	1. Congruence 2. Similarity	1. Translate, Rotate, and Reflect figures 2. Describe the steps to derive one figure from another

8.G.5: Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Sum of the interior angles on a triangle is 180 degrees. 2. Vertical Angles are equal 3. Supplementary Angles add up to 180 degrees 4. Similar triangles have corresponding angles that are congruent.	1. Similarity 2. Congruence 3. Vertical Angles 4. Supplementary Angles	1. Arrange the angles on at triangle so they form a line. 2. Make informal arguments about the angles formed from a transversal. 3. Make informal arguments about the angles in similar triangles.

8.G.6: Explain a proof of the Pythagorean Theorem and its converse.		
Grade 8 Enduring Understandings		
Students will know… 1. Pythagorean Theorem, Converse	***Students will understand…*** 1. If a triangle is a right triangle then the sum of the squares of the legs equals the square of the hypotenuse. 2. If the sum of the squares of the shorter sides equals the square of the longer side, then the triangle is a right triangle.	***Students will be able to…*** 1. Explain a proof of the Pythagorean Theorem 2. Explain a proof of the converse of the Pythagorean Theorem
8.G.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.		
Grade 8 Enduring Understandings		
Students will know… 1. Pythagorean theorem, unknown side lengths	***Students will understand…*** 1. How to identify the legs and hypotenuse in a right triangle. Use the Pythagorean to determine the unknown length.	***Students will be able to…*** 1. Apply the Pythagorean theorem to determine unknown side lengths in right triangles in two and three dimensions.
8.G.8: Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.		
Grade 8 Enduring Understandings		
Students will know… 1. Coordinate system, Pythagorean theorem	***Students will understand…*** 1. the horizontal and vertical distance between two points 2. use these distances in the Pythagorean theorem	***Students will be able to…*** 1. apply the Pythagorean theorem with ordered pairs on a coordinate graph
8.G.9: Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.		
Grade 8 Enduring Understandings		
Students will know… 1. formulas for volumes, cone, cylinder, sphere	***Students will understand…*** 1. What volume represents 2. How to identify the shape and use the correct formula	***Students will be able to…*** 1. know and use the formulas for volume of cones, cylinders, and spheres

Grade 8 – Number Systems

Essential Questions:

1. Why do we use numbers, what are their properties, and how does our number system function?
2. Why do we use estimation and when is it appropriate?
3. What makes a strategy effective and efficient and the solution reasonable?
4. How do numbers relate and compare to one another?

Essential Vocabulary – rational, irrational, decimal expansion, repeating decimal, rational approximation, irrational, number line diagram, decimal expansion, truncate

8.NS.1: Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Rational, irrational, decimal expansion, repeating decimal	1. the difference between irrational and rational numbers . ..how to convert repeating decimals into a rational representation	1. know that numbers that are not rational are called irrational. Show that a rational number has a decimal expansion that either repeats or terminates. Convert a decimal expansion which repeats into a rational number.

8.NS.2: Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., $\pi 2$). For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. rational approximation, irrational, number line diagram, decimal expansion of irrational value	1. the difference between rational and irrational numbers 2. Their approximate location on a number line and their approximate value	1. Use rational approximations of irrational numbers to compare the size 2. Locate irrational numbers on a number line diagram 3. Estimate the value of an irrational number by truncating the decimal expansion

Grade 8 – Statistics and Probability

Essential Questions:

1. How can we gather, organize and display data to communicate and justify results in the real world?
2. How can we analyze data to make inferences and/or predictions, based on surveys, experiments, probability and observational studies?

Essential Vocabulary – clustering, outliers, positive association, negative association, linear association, and nonlinear association, bivariate, scatter plot, x-axis, y-axis, coordinate plane, straight line, scatter plot, linear, slope, y-intercept, linear equation, bivariate, relative frequencies, categorical data, categorical variables, two-way table, patterns of association

8.SP.1: Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Scatter plots for bivariate measurement data	1. that the scatter plot is a tool to study bivariate measurement data (two sets of data)	1. Construct and interpret scatter plots 2. Investigate patterns between two quantities 3. Describe patterns

8.SP.2: Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. Linear association	1. that a straight line can represent a scatter plot with a linear association	1. identify a straight line that comes closest to most data points

8.SP.3: Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret 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.

Grade 8 Enduring Understandings

Students will know…	***Students will understand…***	***Students will be able to…***
1. The equation of a linear model, slope and intercept in the context of bivariate measurement data	1. That a linear equation can be used to model situations	1. Use the equation of a linear model to solve problems 2. Interpret slope and y-intercept

8.SP.4: Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing dataincldуing data from Montana American Indian sources on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*		
8.SP.4 Statistics and Probability		
Grade 8 Enduring Understandings		
Students will know… 1. Patterns of association in bivariate categorical data, two way table summarizing data on two categorical variables, relative frequencies	***Students will understand…*** 1. that patterns of association can also be seen in bivariate categorical data	***Students will be able to…*** 1. construct and interpret a two-way table summarizing data 2. use relative frequencies calculated for rows or columns to describe possible association between variables