Core Content Connectors

2021

8th Grade

Mathematics

Montana Office of Public Instruction

High Academic Standards For Students

The Core Content Connectors were developed by the National Center and State Collaborative (NCSC) Project under a federal grant.

8th Grade Overview

Core Content Connectors (CCCs) are only used for students with the most significant cognitive disabilities. They identify the most salient grade-level, core academic content in ELA and Mathematics found in both the Montana Content Standards and the Learning Progression Frameworks (LPF). CCCs illustrate the necessary knowledge and skills in order to reach the learning targets within the LPF and the Montana Content Standards, focus on the core content, knowledge and skills needed at each grade to promote success at the next, and identify priorities in each content area to guide the instruction for students in this population and for the alternate assessment. These standards reflect the constitutional mandate that all educators must provide instruction including the distinct and unique heritage and contemporary contributions of American Indians in a culturally responsive manner (See IEFA; MCA 20-1-501 Article X; resources; and materials).

The Number System

- Understand that there are irrational numbers and approximate them using rational numbers.

Expressions and Equations (EE)

- Work with radicals and integer exponents.
- Understand the connections between proportional relationships, lines, and linear equations.
- Analyze and solve linear equations, inequalities, and pairs of simultaneous linear equations.

Functions (F)

- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities.

Geometry (G)

- Understand congruence and similarity.
- Understand and apply the Pythagorean Theorem.
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

Statistics and Probability (SP)

- Reason Investigate patterns of association in bivariate data.
- Investigate chance processes and develop, use, and evaluate probability models.

Standards for Mathematical Practices (MP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

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8th Grade: Critical Areas

In Grade 8, instructional time should focus on three critical areas:

1. **Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations**
    - Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions (y/x = m or y = mx) as special linear equations (y = mx + b), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount m·A. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.
    - Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

2. **Grasping the concept of a function and using functions to describe quantitative relationships**
    - Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

3. **Analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem**
    - Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students

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show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

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	Standards for Mathematical Practice: Grade 8 Explanations and Examples
Standards	**Explanations and Examples**
	The Standards for Mathematical Practice describe ways in which students ought to engage with the subject matter as they grow in mathematical maturity and expertise. Students are expected to:
8.MP.1	**Make sense of problems and persevere solving them** In grade 8, students solve real world problems through the application of algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?"
8.MP.2	**Reason abstractly and quantitatively** In grade 8, students represent a wide variety of real-world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. They examine patterns in data and assess the degree of linearity of functions. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.
8.MP.3	**Construct viable arguments and critique the reasoning of others** In grade 8, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e., box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like "How did you get that?", "Why is that true?" "Does that always work?" They explain their thinking to others and respond to others' thinking.
8.MP.4	**Model with mathematics** In grade 8, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students solve systems of linear equations and compare properties of functions provided in different forms. Students use scatterplots to represent data and describe associations between variables. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context.
8.MP.5	**Use appropriate tools strategically** Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 8 may translate a set of data given in tabular form to a graphical representation to compare it to another data set. Students might draw pictures, use applets, or write equations to show the relationships between the angles created by a transversal.
8.MP.6	**Attend to precision** In grade 8, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to the number system, functions, geometric figures, and data displays.
8.MP.7	**Look for and make use of structure**

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	Students routinely seek patterns or structures to model and solve problems. In grade 8, students apply properties to generate equivalent expressions and solve equations. Students examine patterns in tables and graphs to generate equations and describe relationships. Additionally, students experimentally verify the effects of transformations and describe them in terms of congruence and similarity.
8.MP.8	**Look for and express regularity in repeated reasoning** In grade 8, students use repeated reasoning to understand algorithms and make generalizations about patterns. Students use iterative processes to determine more precise rational approximations for irrational numbers. During multiple opportunities to solve and model problems, they notice that the slope of a line and rate of change are the same value. Students flexibly make connections between covariance, rates, and representations showing the relationships between quantities.

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Grade 8 Overview					
Domains	**The Number System**	**Expressions and Equations**	**Functions**	**Geometry**	**Statistics and Probability**
Clusters	• Know that there are numbers that are not rational, and approximate them by rational numbers	• Work with radicals and integer components • Understand the connections between proportional relationships, lines, and linear equations • Analyze and solve linear equations and pairs of simultaneous linear equations.	• Define, evaluate, and compare functions • Use functions to model relationships between quantities	• Understand congruence and similarity using physical models, transparencies, or geometry software • Understand and apply the Pythagorean Theorem • Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres	• Investigate patterns of association in bivariate data
Mathematical Practices	1. Make sense of problems and persevere in solving them 2. Reason abstractly and quantitatively	3. Construct viable arguments and critique the reasoning of others 4. Model with mathematics	5. Use appropriate tools strategically 6. Attend to precision	7. Look for and make use of structure	8. Look for and express regularity in repeated reasoning

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	Montana's Mathematics Standards – Grade 8
	The Number System (NS)
	Understand that there are irrational numbers, and approximate them using rational numbers
8.NS.1	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. **No CCC developed for this standard.**
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., π2). For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations. **8.NO.1k1 Identify π as an irrational number.** **8.NO.1k2 Round irrational numbers to the hundredths place.** **8.NO.1k3 Use approximations of irrational numbers to locate them on a number line**.

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	Montana's Mathematics Standards – Grade 8
	Expressions and Equations (EE)
	Work with radicals and integer exponents
8.EE.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 32 × 3–5 = 3–3 = 1/33 = 1/27. **No CCC developed for this standard.**
8.EE.2	Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. **No CCC developed for this standard.**
8.EE.3	Use numbers expressed in the form of a single digit times a whole-number 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 times 108 and the population of the world as 7 times 109, and determine that the world population is more than 20 times larger. **8.NO.1i1 Convert a number expressed in scientific notation up to 10,000.**
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. **No CCC developed for this standard.**
	Understand the connections between proportional relationships, lines, and linear equations
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. **8.PRF.1e2 Represent proportional relationships on a line graph.**
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. **No CCC developed for this standard.**
	Analyze and solve linear equations, inequalities, and pairs of simultaneous linear equations
8.EE.7	Solve linear equations in one variable. o 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). o Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

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	8.PRF.1g3 Solve linear equations with 1 variable
8.EE.8	Analyze and solve pairs of simultaneous linear equations. o 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. o 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. o 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. **No CCC developed for this standard.**

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	Montana's Mathematics Standards – Grade 8
	Functions (F)
	Define, evaluate, and compare functions
8.EE.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. [Function notation is not required in Grade 8.] **No CCC developed for this standard.**
8.EE.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. **No CCC developed for this standard.**
8.EE.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 = s2 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. **8.PRF.2c1 Given two graphs, describe the function as linear and not linear.**
	Use functions to model relationships between quantities
8.EE.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. **8.PRF.2e2 Identify the rate of change (slope) and initial value (y-intercept) from graphs.**
8.EE.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. **8.PRF.2c1 Given two graphs, describe the function as linear and not linear.** **8.PRF.2e3 Given a verbal description of a situation, create or identify a graph to model the situation.** **8.PRF.2e4 Given a graph of a situation, generate a description of the situation.** **8.PRF.1f2 Describe or select the relationship between the two quantities given a line graph of a situation.** **8.NO.3c3 Analyze provided information (e.g., a graph) to describe the relationship between two quantities.**

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	Montana's Mathematics Standards – Grade 8
	Geometry (G)
	Understand congruence and similarity
8.G.1	Verify experimentally the properties of rotations, reflections, and translations from a variety of cultural contexts, including those of Montana American Indians: o Lines are taken to lines, and line segments to line segments of the same length. o Angles are taken to angles of the same measure. o Parallel lines are taken to parallel lines. **8.GM.1f1 Recognize a rotation, reflection, or translation of a figure.** **H.GM.1d1 Use the reflections, rotations, or translations in the coordinate plane to solve problems with right 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. **No CCC developed for this standard.**
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. **8.GM.1f2 Identify a rotation, reflection, or translation of a plane figure when given coordinates.**
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. **8.GM.1g1 Recognize congruent and similar figures.** **8.ME.1e1 Describe the changes in surface area, area, and volume when the figure is changed in some (e.g., scale drawings).** **8.ME.1e2 Compare area and volume of similar figures.**
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. **8.GM.1i4 Use angle relationships to find the value of a missing angle.**
	Understand and apply the Pythagorean Theorem
8.G.6	Explain a proof of the Pythagorean Theorem and its converse. **No CCC developed for this standard**.

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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. For example, determine the unknown height of a Plains Indian tipi when given the side length and radius. **8.ME.2f1 Apply the Pythagorean theorem to determine lengths/distances in real-world situations.** **8.GM.1j1 Find the hypotenuse of a two-dimensional right triangle (Pythagorean Theorem).** **8.GM.1j2 Find the missing side lengths of a two-dimensional right triangle (Pythagorean Theorem).** **H.GM.1a1 Find the hypotenuse of a two-dimensional right triangle (Pythagorean Theorem).** **H.GM.1a2 Find the missing side lengths of a two-dimensional right triangle (Pythagorean Theorem).**
8.G.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. **No CCC developed for this standard**.
	Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres
8.G.9	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. **8.ME.2d2 Apply the formula to find the volume of three- dimensional shapes (i.e., cubes, spheres, and cylinders).**

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	Montana's Mathematics Standards – Grade 8
	Statistics and Probability (SP)
	Investigate patterns of association in bivariate data
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. **8.SP.1a Recognize a pattern of association using existing data.** **8.DPS.1g2 Graph data using line graphs, histograms, or box plots.** **8.DPS.1h1 Graph bivariate data using scatter plots and identify possible associations between the variables.** **8.DPS.1i3 Using box plots and scatter plots, identify data points that appear to be outliers**.
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. **8.DPS.2g1 Distinguish between a linear and non-linear association when analyzing bivariate data on a scatter plot.**
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. **8.DPS.2g2 Interpret the slope and the y-intercept of a line in the context of a problem**.
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 data including 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.DPS.1k2 Analyze displays of bivariate data to develop or select appropriate claims about those data.** **8.DPS.1f3 Construct a two-way table summarizing data on two categorical variables collected from the same subjects; identify possible association between the two variables.**

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