NEW MEXICO
Public Education Department

8.EE: EXPRESSIONS & EQUATIONS

Cluster Statement: C: Analyze and solve linear equations and pairs of simultaneous linear equations.

Major Cluster (Students should spend the large majority of their time (65-85%) on the major work of the grade/course. Supporting work and, where appropriate, additional work should be connected to and engage students in the major work of the grade.)

Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
8.EE.C.7: Solve linear equations in one variable. • **8.EE.C.7.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).** • **8.EE.C.7.B:Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.**	SMP 1: Students make sense of problems and persevere in solving them by solving real-world systems of linear equations and interpreting the results. SMP 2: Students reason abstractly and quantitatively by representing a real-world situation by writing a linear equation (or system of linear equations), then interpreting the meaning of the solution. Students explain the type of solution a system of linear equations will produce (one solution, no solution, or infinitely many solutions) by looking at the graph or system of equations. SMP 3: Students construct viable arguments and critique the reasoning of others by justifying the most efficient solution method of a system of linear equations. SMP 4: Students model with mathematics by writing and solving a system of linear equations to determine the solution of a real-world problem. SMP 5: Students use appropriate tools strategically by using a graphing calculator and/or graph paper for a coordinate grid to write and solve linear equations and/or a system of linear equations.	• Combine like terms. • Expand an equation using the distributive property. • Solve one step equations, two step equations and multi-step (including equations where you must combine like terms and expand using the distributive property). • Use inverse operations to solve equations. • Determine whether an equation will have one solution (x=a), no solution (a=b) or infinite solutions (a=a) by simplifying the equation. (a and b are numbers). **Webb's Depth of Knowledge:** 2-3 **Bloom's Taxonomy:** Apply, Evaluate

	SMP 6: Students attend to precision by appropriately labeling the solution of a linear equation or a system of linear equations. SMP 7: Students look for and make use of structure by applying inverse operations and algebraic reasoning to solve a linear equation or a system of linear equations.	
Standard Text **8.EE.C.8: Analyze and solve pairs of simultaneous linear equations.** • **8.EE.C.8.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.** • **8.EE.C.8.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.*** • **8.EE.C.8.C: Solve real-world and mathematical problems 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.***	**Standard for Mathematical Practices** SMP 1: Students make sense of problems and persevere in solving them by solving real-world systems of linear equations and interpreting the results. SMP 2: Students reason abstractly and quantitatively by representing a real-world situation by writing a linear equation (or system of linear equations), then interpreting the meaning of the solution. Students explain the type of solution a system of linear equations will produce (one solution, no solution, or infinitely many solutions) by looking at the graph or system of equations. SMP 3: Students construct viable arguments and critique the reasoning of others by justifying the most efficient solution method of a system of linear equations. SMP 4: Students model with mathematics by writing and solving a system of linear equations to determine the solution of a real-world problem. SMP 5: Students use appropriate tools strategically by using a graphing calculator and/or graph paper for a coordinate grid to write and solve linear equations and/or a system of linear equations.	**Students who demonstrate understanding can:** • Calculate two linear equations with two variables in a real-world problem. • Calculate the value of two variables from two linear equations either algebraically or graphically. • Graph two equations and estimate solutions. • Analyze and solve systems of two linear equations with two variables in real-world problems. • Solve systems of two linear equations in two variables algebraically and/or graphically. • Estimate solutions by graphing the equations. • Solve simple cases by inspection. **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** Apply, analyze

	SMP 6: Students attend to precision by appropriately labeling the solution of a linear equation or a system of linear equations. SMP 7: Students look for and make use of structure by applying inverse operations and algebraic reasoning to solve a linear equation or a system of linear equations.	
Previous Learning Connections: • In 6th and 7th grade, students use variables to write expressions and equations and apply the properties of operations to generate equivalent expressions. Students also solve equations, including those that involve real-world problems.	**Current Learning Connections** • In 8th grade, students use the equation of a linear model to solve problems in the context of bivariate (two variables) measurement data, interpreting the slope and intercept. Students will use these equations to graph linear and proportional relationships.	**Future Learning Connections** • In high school, students will create, solve, and rewrite equations, inequalities, and systems of equations (include equations arising from linear, exponential, and quadratic functions) They will make connections to this content to construct a viable argument to justify a solution method.

Clarification Statement:
Students analyze, solve, and interpret linear equations and systems of linear equations.

Common Misconceptions

- Students may make errors if they substitute incorrectly or confuse the variable terms and the constant.
- Students may confuse the slope and y-intercept. Some students might forget that the way two lines intersect or do not intersect shows the number of solutions for a system of equations. They may make the error of solving an equation by substituting in only one equation in the system, try to use elimination without eliminating a variable, or become confused as to where to include given information into an equation.

Multi-Layered System of Supports (MLSS)/Suggested Instructional Strategies

Pre-Teach

Pre-teach (targeted): *What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*

- For example, some learners may benefit from targeted pre-teaching that provides additional time for confusion to happen with new mathematical ideas when studying analyzing and solving linear equations and pairs of simultaneous linear equations because 8th grade is the first time students will be connecting equation with lines and graphs and interpreting graphs to find solutions for linear equations. Students' previous work with linear equations stopped at isolating and solving for single variables by using inverse operations. Students will need additional time to connect the values in an equation to graphing and drawing conclusions from graphed lines.

Pre-teach (intensive): *What critical understandings will prepare students to access the mathematics for this cluster?*

- 6.EE.B.5 AND 7.EE.B.4: These standards provide a foundation for work with analyzing and solving linear equations and pairs of simultaneous linear equations because it is critical that students understand that an equation can be simplified and solved by using a specific process. Students must understand the context of the variable, and its real-world implication. If students have unfinished learning within this standard, based on

assessment data, consider ways to provide intensive pre-teaching support prior to the start of the unit to ensure students are ready to access grade level instruction and assignments.

Core Instruction

Access

Interest: *How will the learning for students provide multiple options for recruiting student interest?*

- For example, learners engaging with analyzing and solving linear equations and pairs of simultaneous linear equations benefit when learning experiences include ways to recruit interest such as creating an accepting and supportive classroom climate because < errors and mistakes will be made when students are learning to master this cluster. Student's work in previous grade levels asked students to solve for single variables with rational coefficients, stressing inverse operations. This cluster includes multiple variables, multiple solutions, ordered pairs, connecting graphing lines to equations and solutions to points of intersection, all of which is brand new learning to 8th grade students. Creating an accepting and sporting classroom climate, where mistakes are common and accepted, may additionally support students in the learning process and aid in their persistence to keep trying.

Build

Effort and Persistence: *How will the learning for students provide options for sustaining effort and persistence?*

- For example, learners engaging with analyzing and solving linear equations and pairs of simultaneous linear equations benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as using prompts or scaffolds for visualizing desired outcomes because previous learning in this concept prepares students for using distributive property, combining like terms, and isolating a single variable, yet these skills are steps to mastery in the 8th grade cluster. Affirming success with these skills and using the as scaffolds to reach mastery in this cluster will aid students in reaching the desired outcome.

Language and Symbols: *How will the learning for students provide alternative representations to ensure accessibility, clarity and comprehensibility for all learners? (e.g., a graph illustrating the relationship between two variables may be informative to one learner and inaccessible or puzzling to another; picture or image may carry very different meanings for learners from differing cultural or familial backgrounds)*

- For example, learners engaging with analyzing and solving linear equations and pairs of simultaneous linear equations benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity can comprehensibility for all learners such as highlighting how complex terms, expressions, or equations are composed of simpler words or symbols by attending to the structure because success in this standard is when students can draw connections between equations, solutions, and graphic representations of the linear equations, and graphed solutions contained within the lines drawn. breaking down the complex components of linear equations, especially with rational coefficients, and simplifying each piece with words and symbols and begin to create connections between what is written, what is graphed, and what certain points on the graph represent when it comes to solutions.

Expression and Communication: How will the learning provide multiple modalities for students to easily express knowledge, ideas, and concepts in the learning environment?

- For example, learners engaging with analyzing and solving linear equations and pairs of simultaneous linear equations benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as <providing calculators, graphing calculators, geometric sketchpads, or pre-formatted graph paper because <precision in graphing ordered pairs and solutions is essential when understanding how a values of ordered pairs on a graph relates to an the values written in an equation. Although this cluster includes rational coefficients, manipulating rational coefficients is not the heart of the cluster, and therefore providing calculator aides will create equal access for students of all computation skills to communicate what they understand about linear equations.

Internalize

Executive Functions: *How will the learning for students support the development of executive functions to allow them to take advantage of their environment?*

- For example, learners engaging with analyzing and solving linear equations and pairs of simultaneous linear equations benefit when learning experiences provide opportunities for students to set goals; formulate plans; use tool and processes to support organization and memory; and analyze their growth in learning and how to build from it such as providing checklists and project planning templates for understanding the problem, setting up prioritization, sequences, and schedules of steps because this cluster represents a culmination of skills. Students will need to appropriately use the four operations with rational coefficients adhering to order of operations, use the distributive property, combine like terms, isolate variables using inverse operations, identify graphed values in ordered pairs, connect slope-intercept form to graph representations, and analyze how ordered pairs would fall on a line based upon the equation and the slope of the line. Creating processes, steps, and sequences will create reliable systems that students can depend on while navigating skills they may be comfortable with and brand-new skills.

Re-teach

Re-teach (targeted): *What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisiting during a unit?*

- For example, students may benefit from re-engaging with content during a unit on analyzing and solving linear equations and pairs of simultaneous linear equations by clarifying mathematical ideas and/or concepts through a short mini-lesson because students may struggle procedurally to solve linear equations for solutions, especially when working with rational coefficients, and without this crucial understanding, students will struggle with the entirety of the cluster.

Re-teach (intensive): *What assessment data will help identify content needing to be revisited for intensive interventions?*

- For example, some students may benefit from intensive extra time during and after a unit in analyzing and solving linear equations and pairs of simultaneous linear equations by confronting student misconceptions because many misconceptions in this unit reflect low procedure and fluency skills when it comes to manipulating values using the four operations or reading a graph and understanding x values, y values. Confronting misconceptions about appropriately and correctly using the four operations and recognizing key components of general graphs can improve student learning as these skills are extended with linear equations and graph reading.

Extension

What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?

- For example, some learners may benefit from an extension such as the application of and development of abstract thinking skills when studying analyzing and solving linear equations and pairs of simultaneous linear equations because the recognition of solutions satisfying simultaneous equations is clear and non-examples are also clear when looking at a graph, however justifying an example from a non-example becomes abstract when placed in context. Students needing extension could be given graphs of examples and non-examples and be asked to create real-world mathematical word problems that could be represented by each graph.

Culturally and Linguistically Responsive Instruction:
Validate/Affirm: How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?
Build/Bridge: How can you create connections between the cultural and linguistic behaviors of your students' home culture and language the culture and language of school mathematics to support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?

Building Procedural Fluency from Conceptual Understanding: Instruction should build from conceptual understanding to allow students opportunities to make meaning of mathematics before focusing on procedures. When new learning begins with procedures it privileges those with strong prior familiarity with school mathematics procedures for solving problems and does not allow learning to build for more methods for solving tasks that occur outside of school mathematics. For example, when studying how to analyze and solve linear equations and pairs of simultaneous linear equations the types of mathematical tasks are critical because students should understand where to look on a graph to find the solution. They should be able to analyze and interpret the solution when the lines intersect, when they are parallel or when they coincide.

Standards Aligned Instructionally Embedded Formative Assessment Resources:
Source:
http://s3.amazonaws.com/illustrativemathematics/attachments/000/008/757/original/public_task_472.pdf?1462392465

8.EE.C.8 Analyze and solve linear equations and pairs of simultaneous linear equations.

- Learning Target: I can solve linear equations and pairs of simultaneous linear equations.
- Webb's Depth of Knowledge*: 3*
- This task can be used to both assess student understanding of systems of linear equations or to promote discussion and student thinking that would allow for a stronger solidification of these concepts. The solution can be determined in multiple ways, including either a graphical or algebraic approach.

Ivan's furnace has quit working during the coldest part of the year, and he is eager to get it fixed. He decides to call some mechanics and furnace specialists to see what it might cost him to have the furnace fixed. Since he is unsure of the parts he needs, he decides to compare the costs based only on service fees and labor costs. Shown below are the price estimates for labor that were given to him by three different companies. Each company has given the same time estimate for fixing the furnace.

- Company A charges $35 per hour to its customers.
- Company B charges a $20 service fee for coming out to the house and then $25 per hour for each additional hour.
- Company C charges a $45 service fee for coming out to the house and then $20 per hour for each additional hour.

For which time intervals should Ivan choose Company A, Company B, Company C? Support your decision with sound reasoning and representations. Consider including equations, tables, and graphs.

Relevance to families and communities:	Cross-Curricular Connections:
During a unit focused on how to analyze and solve linear equations and pairs of simultaneous linear equations, consider options for learning from your families and communities the cultural and linguistic ways this mathematics exists outside of school to create stronger home to school connections for students, for example, provide students with real-world examples that are in context and relative to their cultural and linguistic background. Provide questions that help them make connections to concepts and their cultural understanding of math.	Science: Compare linear relationships and systems of equations in scientific data.