



Topic C:

Systems of Linear Equations

N-VM.C.10, A-REI.C.8, A-REI.C.9

Focus Standards:	N-VM.C.10	(+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
	A-REI.C.8	(+) Represent a system of linear equation as a single matrix equation in a vector variable.
	A-REI.C.9	(+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3×3 or greater).
Instructional Days: 3		
Lesson 14: Solving Equations Involving Linear Transformations of the Coordinate Plane (P) ¹		
Lesson 15: Solving Equations Involving Linear Transformations of the Coordinate Space (P)		
Lesson 16: Solving General Systems of Linear Equations (P)		

Topic C provides a third context for the appearance of matrices via the study of systems of linear equations. Students see that a system of linear equations can be represented as a single matrix equation in a vector variable (**A-REI.C.8**) and that one can solve the system with the aid of the multiplicative inverse to a matrix, if it exists (**A-REI.C.9**, **N-VM.C.10**).

In Lesson 14, students will explore the relationship between linear transformations of points in two-dimensional space and systems of equations. They represent systems of equations as linear transformations represented by matrix equations and apply inverse matrix multiplication to find the solutions to systems of equations, establishing a foundation for solving systems of three or more equations using inverse matrix operations (**A-REI.C.8**, **A-REI.C.9**, **N-VM.C.10**). This work is expanded in Lesson 15 to more complicated systems of equations as students use software to calculate inverse matrices for systems of degree 3 and apply the inverse of the coefficient matrix to the linear transformation equation to solve systems (**A-REI.C.8**, **A-REI.C.9**, **N-VM.C.10**). Topic C concludes with Lesson 16 as students discover that, while it is difficult to geometrically describe linear transformations in four- or higher-dimensional space, the mathematics behind representing systems of equations as a linear transformation using matrices is valid for higher-degree space.

¹ Lesson Structure Key: **P**-Problem Set Lesson, **M**-Modeling Cycle Lesson, **E**-Exploration Lesson, **S**-Socratic Lesson

They apply this reasoning to represent complicated systems of equations using matrices and use technology to solve the systems (**A-REI.C.8, A-REI.C.9, N-VM.C.10**).

Throughout Topic C, students are using calculators to perform matrix operations, find the inverse of matrices, and solve systems of equations with matrices (MP.5). Students also see that the structure of solving systems does not change as systems become more complicated or bigger in size (MP.7).