Precalculus | Arkansas Mathematics Standards Correlation to *Eureka Math*®

About *Eureka Math*

Created by Great Minds®, a mission-driven Public Benefit Corporation, *Eureka Math*® helps teachers deliver unparalleled math instruction that provides students with a deep understanding and fluency in math. Crafted by teachers and math scholars, the curriculum carefully sequences the mathematical progressions to maximize coherence from Prekindergarten through Precalculus—a principle tested and proven to be essential in students' mastery of math.

Teachers and students using *Eureka Math* find the trademark "Aha!" moments in *Eureka Math* to be a source of joy and inspiration, lesson after lesson, year after year.

Aligned

Great Minds offers detailed analyses that demonstrate how each grade of *Eureka Math* aligns with specific state standards. Access these free alignment studies at greatminds.org/state-studies.

Data

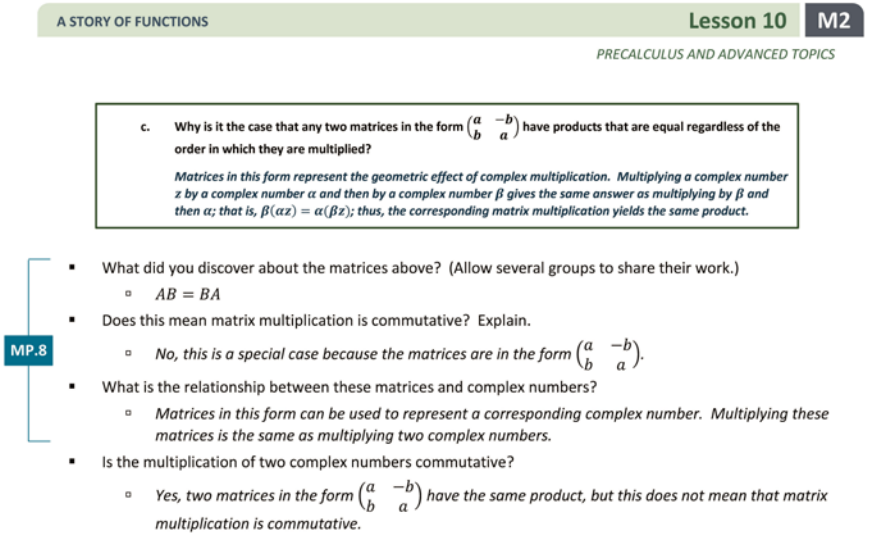
Schools and districts nationwide are experiencing student growth and impressive test scores after using *Eureka Math*. See their stories and data at greatminds.org/data.

Full Suite of Resources

Great Minds offers the *Eureka Math* curriculum as PDF downloads for free, noncommercial use. Access the free PDFs at greatminds.org/math/curriculum.

The teacher–writers who created the curriculum have also developed essential resources, available only from Great Minds, including the following:

- Printed material in English and Spanish
- Digital resources
- Professional development
- Classroom tools and manipulatives
- Teacher support materials
- Parent resources

Standards for Mathematical Practice	Aligned Components of *Eureka Math*
MP.1 Make sense of problems and persevere in solving them.	Lessons in every module engage students in mathematical practices. These are designated in the Module Overview and labeled in lessons. For example: 
MP.2 Reason abstractly and quantitatively.	
MP.3 Construct viable arguments and critique the reasoning of others.	
MP.4 Model with mathematics.	
MP.5 Use appropriate tools strategically.	
MP.6 Attend to precision.	
MP.7 Look for and make use of structure.	
MP.8 Look for and express regularity in repeated reasoning.	

Vectors & Matrices

Vector Quantities

Students recognize, model, and write vector quantities.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.VM.1 Recognize that vector quantities have both magnitude and direction and can be represented by directed line segments.	Precalculus and Advanced Topics M2 Lesson 17: Vectors in the Coordinate Plane Precalculus and Advanced Topics M2 Lesson 18: Vectors and Translation Maps Precalculus and Advanced Topics M2 Lesson 20: Vectors and Stone Bridges
PC.VM.2 Write vector quantities using appropriate symbols indicating magnitude and direction.	Precalculus and Advanced Topics M2 Lesson 17: Vectors in the Coordinate Plane Precalculus and Advanced Topics M2 Lesson 18: Vectors and Translation Maps Precalculus and Advanced Topics M2 Lesson 20: Vectors and Stone Bridges

Vectors & Matrices

Vector Operations

Students perform operations involving vectors.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.VM.3 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.	Precalculus and Advanced Topics M2 Lesson 19: Directed Line Segments and Vectors
PC.VM.4 Solve problems involving velocity and other quantities that can be represented by vectors.	Precalculus and Advanced Topics M2 Lesson 17: Vectors in the Coordinate Plane Precalculus and Advanced Topics M2 Lesson 20: Vectors and Stone Bridges Precalculus and Advanced Topics M2 Lesson 23: Why Are Vectors Useful?

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.VM.5 Add and subtract vectors graphically and algebraically.	Precalculus and Advanced Topics M2 Lesson 5: Coordinates of Points in Space Precalculus and Advanced Topics M2 Lesson 6: Linear Transformations as Matrices Precalculus and Advanced Topics M2 Lesson 17: Vectors in the Coordinate Plane Precalculus and Advanced Topics M2 Lesson 18: Vectors and Translation Maps Precalculus and Advanced Topics M2 Lesson 19: Directed Line Segments and Vectors Precalculus and Advanced Topics M2 Lesson 20: Vectors and Stone Bridges Precalculus and Advanced Topics M2 Lesson 23: Why Are Vectors Useful? Precalculus and Advanced Topics M2 Lesson 24: Why Are Vectors Useful?
PC.VM.6 Multiply a vector by a scalar graphically and analytically; reverse their direction when possible.	Precalculus and Advanced Topics M2 Lesson 5: Coordinates of Points in Space Precalculus and Advanced Topics M2 Lesson 6: Linear Transformations as Matrices Precalculus and Advanced Topics M2 Lesson 17: Vectors in the Coordinate Plane Precalculus and Advanced Topics M2 Lesson 18: Vectors and Translation Maps Precalculus and Advanced Topics M2 Lesson 20: Vectors and Stone Bridges

Vectors & Matrices

Matrix Operations

Students represent and perform operations with matrices.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.VM.7 Use matrices to list, describe, and manipulate data with and without technology.	Precalculus and Advanced Topics M2 Topic A: Networks and Matrices

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.VM.8 Multiply matrices, understanding that matrix multiplication for square matrices is not commutative.	Precalculus and Advanced Topics M2 Lesson 10: Matrix Multiplication Is Not Commutative Precalculus and Advanced Topics M2 Lesson 12: Matrix Multiplication Is Distributive and Associative
PC.VM.9 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.	Precalculus and Advanced Topics M1 Lesson 24: Matrix Notation Encompasses New Transformations! Precalculus and Advanced Topics M1 Lesson 25: Matrix Multiplication and Addition Precalculus and Advanced Topics M1 Lesson 26: Getting a Handle on New Transformations Precalculus and Advanced Topics M1 Lesson 27: Getting a Handle on New Transformations Precalculus and Advanced Topics M1 Lesson 28: When Can We Reverse a Transformation? Precalculus and Advanced Topics M1 Lesson 29: When Can We Reverse a Transformation? Precalculus and Advanced Topics M1 Lesson 30: When Can We Reverse a Transformation? Precalculus and Advanced Topics M2 Lesson 6: Linear Transformations as Matrices Precalculus and Advanced Topics M2 Lesson 13: Using Matrix Operations for Encryption Precalculus and Advanced Topics M2 Topic C: Systems of Linear Equations
PC.VM.10 Work with 2×2 matrices as transformations of the plane; interpret the absolute value of the determinant in terms of area.	Precalculus and Advanced Topics M1 Lesson 21: The Hunt for Better Notation Precalculus and Advanced Topics M1 Lesson 22: Modeling Video Game Motion with Matrices Precalculus and Advanced Topics M1 Lesson 23: Modeling Video Game Motion with Matrices Precalculus and Advanced Topics M1 Lesson 26: Getting a Handle on New Transformations Precalculus and Advanced Topics M1 Lesson 27: Getting a Handle on New Transformations Precalculus and Advanced Topics M1 Lesson 28: When Can We Reverse a Transformation? Precalculus and Advanced Topics M1 Lesson 29: When Can We Reverse a Transformation? Precalculus and Advanced Topics M1 Lesson 30: When Can We Reverse a Transformation? Precalculus and Advanced Topics M2 Lesson 8: Composition of Linear Transformations

Trigonometry

Radians

Students understand, explain, and describe radian measure.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.TR.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	Algebra II M2 Lesson 9: Awkward! Who Chose the Number 360, Anyway?
PC.TR.2 Convert between radian and degree measure.	Algebra II M2 Lesson 9: Awkward! Who Chose the Number 360, Anyway?
PC.TR.3 Explain how the unit circle can be used to model sine, cosine, tangent, secant, cosecant, and cotangent for all real numbers.	Algebra II M2 Lesson 1: Ferris Wheels—Tracking the Height of a Passenger Car Algebra II M2 Lesson 2: The Height and Co-Height Functions of a Ferris Wheel Algebra II M2 Lesson 3: The Motion of the Moon, Sun, and Stars—Motivating Mathematics Algebra II M2 Lesson 4: From Circle-ometry to Trigonometry Algebra II M2 Lesson 5: Extending the Domain of Sine and Cosine to All Real Numbers Algebra II M2 Lesson 7: Secant and the Co-Functions

Trigonometry

Unit Circle

Students use the unit circle to express and find exact values for trigonometric functions.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.TR.4 Construct special right triangles on the unit circle to find the exact values of sine, cosine, tangent for $\frac{\pi}{3}$, $\frac{\pi}{4}$, $\frac{\pi}{6}$, and $\frac{\pi}{2}$.	Algebra II M2 Lesson 4: From Circle-ometry to Trigonometry Algebra II M2 Lesson 5: Extending the Domain of Sine and Cosine to All Real Numbers Algebra II M2 Lesson 6: Why Call It Tangent? Algebra II M2 Lesson 10: Basic Trigonometric Identities from Graphs Precalculus and Advanced Topics M4 Lesson 1: Special Triangles and the Unit Circle
PC.TR.5 Use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their exact values for x, where x is one of these values: $\frac{\pi}{3}$, $\frac{\pi}{4}$, $\frac{\pi}{6}$, and $\frac{\pi}{2}$.	Algebra II M2 Lesson 4: From Circle-ometry to Trigonometry Algebra II M2 Lesson 5: Extending the Domain of Sine and Cosine to All Real Numbers Algebra II M2 Lesson 6: Why Call It Tangent? Algebra II M2 Lesson 10: Basic Trigonometric Identities from Graphs Precalculus and Advanced Topics M4 Lesson 1: Special Triangles and the Unit Circle

Trigonometry

Identities, Formulas, & Laws

Students develop and apply identities, formulas, and laws using trigonometry.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.TR.6 Develop the Pythagorean identity, $\sin^2(\theta) + \cos^2(\theta) = 1$.	Algebra II M2 Lesson 15: What Is a Trigonometric Identity?

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.TR.7 Apply the Pythagorean identity to find the remaining trigonometric functions when given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.	Algebra II M2 Lesson 15: What Is a Trigonometric Identity? Algebra II M2 Lesson 16: Proving Trigonometric Identities
PC.TR.8 Develop addition, subtraction, double, and half-angle formulas for sine, cosine, and tangent and use them to solve problems, including verifying other identities.	Precalculus and Advanced Topics M4 Lesson 3: Addition and Subtraction Formulas Precalculus and Advanced Topics M4 Lesson 4: Addition and Subtraction Formulas Precalculus and Advanced Topics M4 Lesson 6: Waves, Sinusoids, and Identities
PC.TR.9 Develop the formula for the area of a triangle, $A = \left(\frac{1}{2}\right)ab \sin C$, using trigonometry.	Precalculus and Advanced Topics M4 Lesson 7: An Area Formula for Triangles
PC.TR.10 Develop and apply the Law of Sines and the Law of Cosines to solve real-world and mathematical problems including finding unknown measurements in right and non-right triangles.	Precalculus and Advanced Topics M4 Lesson 8: Law of Sines Precalculus and Advanced Topics M4 Lesson 9: Law of Cosines Precalculus and Advanced Topics M4 Lesson 10: Putting the Law of Cosines and the Law of Sines to Use
PC.TR.11 Define and use reciprocal functions, cosecant, secant, and cotangent to solve problems.	Algebra II M2 Lesson 7: Secant and the Co-Functions

Trigonometry

Solve & Graph

Students explore, solve, and sketch the graphs of periodic trigonometric functions.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.TR.12 Explain whether a trigonometric function is even or odd and recognize the periodicity of the graph using the unit circle.	Precalculus and Advanced Topics M4 Lesson 2: Properties of Trigonometric Functions
PC.TR.13 Graph trigonometric and inverse trigonometric functions and show period, midline, and amplitude.	Algebra II M2 Lesson 8: Graphing the Sine and Cosine Functions Algebra II M2 Lesson 11: Transforming the Graph of the Sine Function Algebra II M2 Lesson 12: Ferris Wheels—Using Trigonometric Functions to Model Cyclical Behavior Algebra II M2 Lesson 14: Graphing the Tangent Function Precalculus and Advanced Topics M4 Lesson 11: Revisiting the Graphs of the Trigonometric Functions
PC.TR.14 Select a trigonometric function that models real-world contexts.	Algebra II M2 Lesson 11: Transforming the Graph of the Sine Function Algebra II M2 Lesson 12: Ferris Wheels—Using Trigonometric Functions to Model Cyclical Behavior Algebra II M2 Lesson 13: Tides, Sound Waves, and Stock Markets Algebra II M2 Lesson 14: Graphing the Tangent Function Precalculus and Advanced Topics M4 Lesson 6: Waves, Sinusoids, and Identities
PC.TR.15 Explain how restricting the domain of a trigonometric function allows the creation of its inverse.	Precalculus and Advanced Topics M4 Lesson 12: Inverse Trigonometric Functions

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.TR.16 Solve and evaluate the solution of trigonometric equations in real-world contexts; interpret the solution in terms of its context.	Precalculus and Advanced Topics M4 Lesson 12: Inverse Trigonometric Functions Precalculus and Advanced Topics M4 Lesson 13: Modeling with Inverse Trigonometric Functions Precalculus and Advanced Topics M4 Lesson 14: Modeling with Inverse Trigonometric Functions
PC.TR.17 Recognize that some trigonometric equations have infinitely many solutions and be able to state a general formula to represent the infinite solutions.	*Supplemental material is necessary to address this standard.*
PC.TR.18 Calculate and interpret the average rate of change over a specified interval of a trigonometric function represented in a table, graph, or as an equation in the context of real-world and mathematical problems.	*Supplemental material is necessary to address this standard.*

Conic Sections

Derive Equations

Students derive equations for conic sections.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.CS.1 Derive the general form of the equation of a circle using the Distance Formula or Pythagorean Theorem.	Geometry M5 Lesson 17: Writing the Equation for a Circle Geometry M5 Lesson 18: Recognizing Equations of Circles

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.CS.2 Derive the equation of a parabola given a focus and directrix.	Algebra II M1 Lesson 33: The Definition of a Parabola Algebra II M1 Lesson 34: Are All Parabolas Congruent? Algebra II M1 Lesson 35: Are All Parabolas Similar?
PC.CS.3 Derive the equations of ellipses and hyperbolas given the foci using the Distance Formula.	Precalculus and Advanced Topics M3 Lesson 7: Curves from Geometry Precalculus and Advanced Topics M3 Lesson 8: Curves from Geometry

Conic Sections

Explore Equations

Students identify, analyze, and sketch the graphs of the conic sections and relate their equations and graphs.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.CS.4 Find the equations for the asymptotes of a hyperbola.	Precalculus and Advanced Topics M3 Lesson 8: Curves from Geometry
PC.CS.5 Generate an equivalent form of an equation for a conic section by completing the square to identify key characteristics.	*Supplemental material is necessary to address this standard.*
PC.CS.6 Identify, graph, write, and analyze equations of each type of conic section using properties and technology when appropriate.	Precalculus and Advanced Topics M3 Lesson 7: Curves from Geometry Precalculus and Advanced Topics M3 Lesson 8: Curves from Geometry

Conic Sections

Systems of Equations & Inequalities

Students solve systems of equations and inequalities involving conic sections.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.CS.7 Solve systems of equations and inequalities involving conics and other types of equations, with and without technology.	*Supplemental material is necessary to address this standard.*

Functions

Solve Problems

Students derive and apply functions.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.FN.1 Understand that sequences are functions, sometimes defined recursively, whose domains are a subset of the integers.	Algebra I M3 Lesson 2: Recursive Formulas for Sequences Algebra I M3 Lesson 3: Arithmetic and Geometric Sequences Algebra I M3 Lesson 4: Why Do Banks Pay YOU to Provide Their Services? Algebra II M3 Lesson 26: Percent Rate of Change
PC.FN.2 Derive the formula for the sum of a finite geometric series; apply the formula to solve conceptual problems.	Algebra II M3 Topic E: Geometric Series and Finance

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.FN.3 Apply the Binomial Theorem for the expansion of $(a + b)^n$ in powers of a and b for a positive integer n, where a and b are any number.	Precalculus and Advanced Topics M3 Lesson 4: The Binomial Theorem Precalculus and Advanced Topics M3 Lesson 5: The Binomial Theorem
PC.FN.4 Build functions to model real-world contexts using algebraic operations on functions and composition, with and without appropriate technology.	Precalculus and Advanced Topics M3 Lesson 17: Solving Problems by Function Composition Precalculus and Advanced Topics M3 Lesson 21: Logarithmic and Exponential Problem Solving Precalculus and Advanced Topics M4 Lesson 6: Waves, Sinusoids, and Identities Precalculus and Advanced Topics M4 Lesson 13: Modeling with Inverse Trigonometric Functions Precalculus and Advanced Topics M4 Lesson 14: Modeling with Inverse Trigonometric Functions

Functions

Explore Graphing

Students graph and interpret functions.

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.FN.5 Graph power and polynomial functions, identify zeros (when suitable factorizations are available), and show end behavior.	Algebra II M1 Lesson 15: Structure in Graphs of Polynomial Functions Algebra II M1 Lesson 16: Modeling with Polynomials—An Introduction
PC.FN.6 Graph rational functions, identify zeros, holes and asymptotes (when suitable factorizations are available), and show end behavior.	Precalculus and Advanced Topics M3 Lesson 12: End Behavior of Rational Functions Precalculus and Advanced Topics M3 Lesson 13: Horizontal and Vertical Asymptotes of Graphs of Rational Functions Precalculus and Advanced Topics M3 Lesson 14: Graphing Rational Functions Precalculus and Advanced Topics M3 Lesson 15: Transforming Rational Functions

Arkansas Mathematics Standards	Aligned Components of *Eureka Math*
PC.FN.7 Graph exponential and logarithmic functions; show intercepts and end behavior.	Algebra II M3 Lesson 18: Graphs of Exponential Functions and Logarithmic Functions Algebra II M3 Lesson 20: Transformations of the Graphs of Logarithmic and Exponential Functions Algebra II M3 Lesson 33: The Million Dollar Problem
PC.FN.8 Compare key features of two functions each represented in a different way.	Algebra I M4 Lesson 22: Comparing Quadratic, Square Root, and Cube Root Functions Represented in Different Ways Algebra II M3 Lesson 27: Modeling with Exponential Functions Algebra II M3 Lesson 28: Newton's Law of Cooling, Revisited Algebra II M3 Lesson 30: Buying a Car Algebra II M3 Lesson 31: Credit Cards