
Precalculus | North Dakota Mathematics K–12 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

Math Attributes

Aligned Components of *Eureka Math*

<p>9–12.MA.P</p> <p>Learners can analyze, execute, critique, and adapt approaches and solutions when problem-solving in novel situations.</p>	<p>Lessons in every module engage students in math attributes. These are indicated in margin notes included with every lesson.</p>
<p>9–12.MA.C</p> <p>Learners can create connections within and across concepts, using supporting evidence to interpret how they originate, extend, and relate to other learning, ideas, and life experiences.</p>	<p>Lessons in every module engage students in math attributes. These are indicated in margin notes included with every lesson.</p>
<p>9–12.MA.R</p> <p>Learners can reason logically, citing evidence to critique and explain what they see, think, and conclude through exploration, generalization, and validation.</p>	<p>Lessons in every module engage students in math attributes. These are indicated in margin notes included with every lesson.</p>

Number and Operations: Learners will develop a foundational understanding of the number system, operations, and computational fluency to create connections and solve problems within and across concepts.

North Dakota Mathematics K–12 Standards	Aligned Components of <i>Eureka Math</i>
<p>11-12.NO.6</p> <p>Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real. Understand the hierarchical relationships among subsets of the complex number system.</p>	<p>Precalculus and Advanced Topics M1 Lesson 5: An Appearance of Complex Numbers</p>
<p>11-12.NO.7</p> <p>Use the definition $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.</p>	<p>Precalculus and Advanced Topics M1 Lesson 4: An Appearance of Complex Numbers</p> <p>Precalculus and Advanced Topics M1 Lesson 5: An Appearance of Complex Numbers</p>
<p>11-12.NO.8</p> <p>Use conjugates to find quotients of complex numbers.</p>	<p>Precalculus and Advanced Topics M1 Lesson 7: Complex Number Division</p> <p>Precalculus and Advanced Topics M1 Lesson 8: Complex Number Division</p> <p>Precalculus and Advanced Topics M1 Lesson 9: The Geometric Effect of Some Complex Arithmetic</p> <p>Precalculus and Advanced Topics M1 Lesson 17: The Geometric Effect of Multiplying by a Reciprocal</p>
<p>11-12.NO.9</p> <p>Apply the Fundamental Theorem of Algebra to determine the number of zeros for polynomial functions. Find all solutions to a polynomial equation.</p>	<p>Precalculus and Advanced Topics M3 Lesson 1: Solutions to Polynomial Equations</p> <p>Precalculus and Advanced Topics M3 Lesson 2: Does Every Complex Number Have a Square Root?</p> <p>Precalculus and Advanced Topics M3 Lesson 3: Roots of Unity</p>

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11-12.NO.10</p> <p>Represent complex numbers on the complex plane in rectangular, trigonometric, and polar forms. Find the modulus (absolute value) of a complex number. Explain why the rectangular, trigonometric, and polar forms of a given complex number represent the same number.</p>	<p>Precalculus and Advanced Topics M1 Lesson 4: An Appearance of Complex Numbers</p> <p>Precalculus and Advanced Topics M1 Lesson 5: An Appearance of Complex Numbers</p> <p>Precalculus and Advanced Topics M1 Lesson 6: Complex Numbers as Vectors</p> <p>Precalculus and Advanced Topics M1 Lesson 8: Complex Number Division</p> <p>Precalculus and Advanced Topics M1 Topic B: Complex Number Operations and Transformations</p> <p>Precalculus and Advanced Topics M1 Lesson 18: Exploiting the Connection to Trigonometry</p> <p>Precalculus and Advanced Topics M1 Lesson 19: Exploiting the Connection to Trigonometry</p> <p>Precalculus and Advanced Topics M1 Lesson 20: Exploiting the Connection to Cartesian Coordinates</p>
<p>11-12.NO.11</p> <p>Represent addition, subtraction, multiplication, conjugation, powers, and roots of complex numbers geometrically on the complex and/or polar plane; use properties of this representation for computation.</p>	<p>Precalculus and Advanced Topics M1 Lesson 6: Complex Numbers as Vectors</p> <p>Precalculus and Advanced Topics M1 Lesson 9: The Geometric Effect of Some Complex Arithmetic</p> <p>Precalculus and Advanced Topics M1 Lesson 10: The Geometric Effect of Some Complex Arithmetic</p> <p>Precalculus and Advanced Topics M1 Lesson 14: Discovering the Geometric Effect of Complex Multiplication</p> <p>Precalculus and Advanced Topics M1 Lesson 15: Justifying the Geometric Effect of Complex Multiplication</p> <p>Precalculus and Advanced Topics M1 Lesson 16: Representing Reflections with Transformations</p> <p>Precalculus and Advanced Topics M1 Lesson 17: The Geometric Effect of Multiplying by a Reciprocal</p> <p>Precalculus and Advanced Topics M1 Lesson 18: Exploiting the Connection to Trigonometry</p> <p>Precalculus and Advanced Topics M1 Lesson 19: Exploiting the Connection to Trigonometry</p> <p>Precalculus and Advanced Topics M1 Lesson 20: Exploiting the Connection to Cartesian Coordinates</p>
<p>11-12.NO.12</p> <p>Extend polynomial identities to the complex numbers.</p>	<p>Precalculus and Advanced Topics M3 Lesson 1: Solutions to Polynomial Equations</p> <p>Precalculus and Advanced Topics M3 Lesson 2: Does Every Complex Number Have a Square Root?</p> <p>Precalculus and Advanced Topics M3 Lesson 3: Roots of Unity</p>

<p style="text-align: center;">North Dakota Mathematics K–12 Standards</p>	<p style="text-align: center;">Aligned Components of <i>Eureka Math</i></p>
<p>11-12.NO.14</p> <p>Recognize vector quantities as having both magnitude and direction, writing them in polar form.</p>	<p>Precalculus and Advanced Topics M2 Lesson 17: Vectors in the Coordinate Plane</p> <p>Precalculus and Advanced Topics M2 Lesson 18: Vectors and Translation Maps</p> <p>Precalculus and Advanced Topics M2 Lesson 20: Vectors and Stone Bridges</p>
<p>11-12.NO.15</p> <p>Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.</p>	<p>Precalculus and Advanced Topics M2 Lesson 19: Directed Line Segments and Vectors</p>
<p>11-12.NO.16</p> <p>Solve problems involving magnitude and direction that can be represented by vectors.</p>	<p>Precalculus and Advanced Topics M2 Lesson 17: Vectors in the Coordinate Plane</p> <p>Precalculus and Advanced Topics M2 Lesson 20: Vectors and Stone Bridges</p> <p>Precalculus and Advanced Topics M2 Lesson 23: Why Are Vectors Useful?</p>

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

11–12.NO.17

Add and subtract vectors.

- a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Know that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.
- b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
- c. Understand that vector subtraction $\mathbf{v} - \mathbf{w}$ is defined as $\mathbf{v} + (-\mathbf{w})$, where $-\mathbf{w}$ is the additive inverse of \mathbf{w} , with the same magnitude as \mathbf{w} and pointing in the opposite direction.

Represent vector subtraction graphically by connecting the tips in the appropriate order and using the components to perform vector subtraction.

- 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?

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11-12.NO.18</p> <p>Multiply a vector by a scalar.</p> <ol style="list-style-type: none"> Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction. Use the components to perform scalar multiplication (e.g., as $c(v_x, v_y) = (cv_x, cv_y)$). Compute the magnitude of a scalar multiple $c\mathbf{v}$ using $\ c\mathbf{v}\ = c \mathbf{v}$. Compute the direction of $c\mathbf{v}$ knowing that when $c \mathbf{v} \neq 0$, the direction of $c\mathbf{v}$ is either along \mathbf{v} (for $c > 0$) or against \mathbf{v} (for $c < 0$). 	<p>Precalculus and Advanced Topics M2 Lesson 5: Coordinates of Points in Space</p> <p>Precalculus and Advanced Topics M2 Lesson 6: Linear Transformations as Matrices</p> <p>Precalculus and Advanced Topics M2 Lesson 17: Vectors in the Coordinate Plane</p> <p>Precalculus and Advanced Topics M2 Lesson 18: Vectors and Translation Maps</p> <p>Precalculus and Advanced Topics M2 Lesson 20: Vectors and Stone Bridges</p>
<p>11-12.NO.19</p> <p>Represent data in a matrix. Perform operations (i.e., addition, subtraction, multiplication) on matrices of appropriate dimensions to solve problems and in context. Know that matrix multiplication is not commutative.</p>	<p>Precalculus and Advanced Topics M1 Lesson 22: Modeling Video Game Motion with Matrices</p> <p>Precalculus and Advanced Topics M1 Lesson 24: Matrix Notation Encompasses New Transformations!</p> <p>Precalculus and Advanced Topics M1 Lesson 25: Matrix Multiplication and Addition</p> <p>Precalculus and Advanced Topics M2 Topic A: Networks and Matrices</p> <p>Precalculus and Advanced Topics M2 Topic B: Linear Transformations of Planes and Space</p> <p>Precalculus and Advanced Topics M2 Topic E: First-Person Video Games—Projection Matrices</p>

Algebraic Reasoning: Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.

North Dakota Mathematics K–12 Standards	Aligned Components of <i>Eureka Math</i>
<p>11-12.AR.5</p> <p>Add, subtract, multiply, and divide rational expressions. Understand that rational expressions form a system analogous to rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression.</p>	<p>Precalculus and Advanced Topics M3 Lesson 10: The Structure of Rational Expressions</p> <p>Precalculus and Advanced Topics M3 Lesson 11: Rational Functions</p>
<p>11-12.AR.11</p> <p>Solve quadratic equations with real coefficients that have solutions of the form $a + bi$ and $a - bi$.</p>	<p><i>Supplemental material is necessary to address this standard.</i></p>
<p>11-12.AR.18</p> <p>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).</p>	<p>Precalculus and Advanced Topics M2 Topic C: Systems of Linear Equations</p>
<p>11-12.AR.19</p> <p>Solve a system of equations in three or more variables with matrices (using technology).</p>	<p>Precalculus and Advanced Topics M2 Topic C: Systems of Linear Equations</p>

<p style="text-align: center;">North Dakota Mathematics K–12 Standards</p>	<p style="text-align: center;">Aligned Components of <i>Eureka Math</i></p>
<p>11–12.AR.20</p> <p>Apply the Binomial Theorem for the expansion of $(ax + by)^n$ in powers of x and y for a positive integer n and integers a and b.</p>	<p>Precalculus and Advanced Topics M3 Lesson 4: The Binomial Theorem</p> <p>Precalculus and Advanced Topics M3 Lesson 5: The Binomial Theorem</p>

Algebraic Reasoning: Learners will look for, generate, and make sense of patterns, relationships, and algebraic symbols to represent mathematical models while adopting approaches and solutions in novel situations.

Functions: Learners will develop a foundational knowledge of functions and use them to model relationships between quantities.

<p style="text-align: center;">North Dakota Mathematics K–12 Standards</p>	<p style="text-align: center;">Aligned Components of <i>Eureka Math</i></p>
<p>11–12.AR.F.1</p> <p>Write a function that describes a relationship between two quantities.</p> <ol style="list-style-type: none"> a. Combine standard function types using arithmetic operations. b. Compose functions. 	<p>Precalculus and Advanced Topics M3 Lesson 16: Function Composition</p> <p>Precalculus and Advanced Topics M3 Lesson 17: Solving Problems by Functions Composition</p> <p>Precalculus and Advanced Topics M4 Lesson 6: Waves, Sinusoids, and Identities</p>

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11-12.AR.F.4</p> <p>Identify the effect of transformations on the graph of a function by replacing $f(x)$ with $af(x)$, $f(bx)$, $f(x - h)$, and $f(x) + k$, for specific values of a, h, and k (both positive and negative). Find the value of a, b, h, and k given the graph of the function. Recognize even and odd functions from their graphs and equations.</p>	<p>Algebra II M1 Lesson 15: Structure in Graphs of Polynomial Functions</p> <p>Algebra II M3 Lesson 20: Transformations of the Graphs of Logarithmic and Exponential Functions</p> <p>Algebra II M3 Lesson 21: The Graph of the Natural Logarithm Function</p> <p>Precalculus and Advanced Topics M3 Lesson 12: End Behavior of Rational Functions</p> <p>Precalculus and Advanced Topics M3 Lesson 15: Transforming Rational Functions</p> <p>Precalculus and Advanced Topics M4 Lesson 11: Revisiting the Graphs of the Trigonometric Functions</p>
<p>11-12.AR.F.5</p> <p>Find inverse functions.</p> <ol style="list-style-type: none"> Verify by composition that one function is the inverse of another. Recognize that the graph of a function and its inverse are reflection images over the line $y = x$. Produce an invertible function from a non-invertible function by restricting the domain. 	<p>Precalculus and Advanced Topics M3 Topic C: Inverse Functions</p>
<p>11-12.AR.F.6</p> <p>Apply the inverse relationship between exponents and logarithms to solve problems.</p>	<p>Precalculus and Advanced Topics M3 Lesson 20: Inverses of Logarithmic and Exponential Functions</p> <p>Precalculus and Advanced Topics M3 Lesson 21: Logarithmic and Exponential Problem Solving</p>

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11–12.AR.F.11</p> <p>Analyze and graph functions expressed symbolically (by hand in simple cases and using technology for more complicated cases), identifying key features of the graph.</p> <p>a. Graph rational functions, identifying domain, range, asymptote(s), removable and non-removable discontinuities, intercepts, behavior at the asymptote(s), and end behavior.</p> <p>b. Graph trigonometric functions, showing period, midline, phase shift, and amplitude.</p>	<p>Algebra II M2 Lesson 8: Graphing the Sine and Cosine Functions</p> <p>Algebra II M2 Lesson 11: Transforming the Graph of the Sine Function</p> <p>Algebra II M2 Lesson 12: Ferris Wheels—Using Trigonometric Functions to Model Cyclical Behavior</p> <p>Algebra II M2 Lesson 14: Graphing the Tangent Function</p> <p>Precalculus and Advanced Topics M3 Lesson 12: End Behavior of Rational Functions</p> <p>Precalculus and Advanced Topics M3 Lesson 13: Horizontal and Vertical Asymptotes of Graphs of Rational Functions</p> <p>Precalculus and Advanced Topics M3 Lesson 14: Graphing Rational Functions</p> <p>Precalculus and Advanced Topics M3 Lesson 15: Transforming Rational Functions</p> <p>Precalculus and Advanced Topics M4 Lesson 11: Revisiting the Graphs of the Trigonometric Functions</p>
<p>11–12.AR.F.15</p> <p>Use properties of logarithms to express the solution to $ab^{ct} = d$ where a, c, and d are real numbers and b is a positive real number. Evaluate the logarithm using technology when appropriate.</p>	<p>Precalculus and Advanced Topics M3 Lesson 20: Inverses of Logarithmic and Exponential Functions</p> <p>Precalculus and Advanced Topics M3 Lesson 21: Logarithmic and Exponential Problem Solving</p>
<p>11–12.AR.F.16</p> <p>Extend right triangle trigonometry and apply knowledge of the unit circle to determine values of sine, cosine, and tangent for multiples of $\frac{\pi}{3}$, $\frac{\pi}{4}$, and $\frac{\pi}{6}$.</p>	<p>Precalculus and Advanced Topics M4 Lesson 1: Special Triangles and the Unit Circle</p>

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11-12.AR.F.19</p> <p>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 values for x, where x is any real number.</p>	<p>Precalculus and Advanced Topics M4 Lesson 1: Special Triangles and the Unit Circle</p>
<p>11-12.AR.F.20</p> <p>Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.</p>	<p>Precalculus and Advanced Topics M4 Lesson 2: Properties of Trigonometric Functions</p>
<p>11-12. AR.F.21</p> <p>Create a trigonometric function to model periodic phenomena.</p>	<p>Precalculus and Advanced Topics M4 Lesson 6: Waves, Sinusoids, and Identities</p>
<p>11-12. AR.F.22</p> <p>Restrict the domain of a trigonometric function to construct its inverse.</p>	<p>Precalculus and Advanced Topics M4 Lesson 12: Inverse Trigonometric Functions</p>
<p>11-12. AR.F.23</p> <p>Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions and interpret them in context.</p>	<p>Precalculus and Advanced Topics M4 Lesson 12: Inverse Trigonometric Functions</p> <p>Precalculus and Advanced Topics M4 Lesson 13: Modeling with Inverse Trigonometric Functions</p> <p>Precalculus and Advanced Topics M4 Lesson 14: Modeling with Inverse Trigonometric Functions</p>
<p>11-12. AR.F.24</p> <p>Know and apply the addition and subtraction formulas for sine, cosine, and tangent to solve problems.</p>	<p>Precalculus and Advanced Topics M4 Lesson 3: Addition and Subtraction Formulas</p> <p>Precalculus and Advanced Topics M4 Lesson 4: Addition and Subtraction Formulas</p> <p>Precalculus and Advanced Topics M4 Lesson 6: Waves, Sinusoids, and Identities</p>

Geometry and Measurement: Learners will use visualization, spatial reasoning, geometric modeling, and measurement to investigate the characteristics of figures, perform transformations, and construct logical arguments.

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11-12.GM.1</p> <p>Write the equation of a conic section given its special features. Convert between the standard form and general form equations of conic sections.</p>	<p>Geometry M5 Lesson 17: Writing the Equation for a Circle</p> <p>Geometry M5 Lesson 18: Recognizing Equations of Circles</p> <p>Algebra II M1 Lesson 33: The Definition of a Parabola</p> <p>Algebra II M1 Lesson 34: Are All Parabolas Congruent?</p> <p>Algebra II M1 Lesson 35: Are All Parabolas Similar?</p> <p>Precalculus and Advanced Topics M3 Lesson 6: Curves in the Complex Plane</p> <p>Precalculus and Advanced Topics M3 Lesson 7: Curves from Geometry</p> <p>Precalculus and Advanced Topics M3 Lesson 8: Curves from Geometry</p>
<p>11-12.GM.2</p> <p>Identify key features of a conic section given its equation. Apply properties of conic sections in context.</p>	<p>Geometry M5 Lesson 17: Writing the Equation for a Circle</p> <p>Geometry M5 Lesson 18: Recognizing Equations of Circles</p> <p>Algebra II M1 Lesson 33: The Definition of a Parabola</p> <p>Algebra II M1 Lesson 34: Are All Parabolas Congruent?</p> <p>Algebra II M1 Lesson 35: Are All Parabolas Similar?</p> <p>Precalculus and Advanced Topics M3 Lesson 6: Curves in the Complex Plane</p> <p>Precalculus and Advanced Topics M3 Lesson 7: Curves from Geometry</p> <p>Precalculus and Advanced Topics M3 Lesson 8: Curves from Geometry</p> <p><i>Supplemental material is necessary to address applying properties of conic sections in context.</i></p>

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11-12.GM.3</p> <p>Determine and apply appropriate formulas to solve right and non-right triangle problems in context.</p>	<p>Geometry M2 Lesson 25: Incredibly Useful Ratios</p> <p>Geometry M2 Lesson 26: The Definition of Sine, Cosine, and Tangent</p> <p>Geometry M2 Lesson 28: Solving Problems Using Sine and Cosine</p> <p>Geometry M2 Lesson 29: Applying Tangents</p> <p>Geometry M2 Lesson 30: Trigonometry and the Pythagorean Theorem</p> <p>Geometry M2 Lesson 31: Using Trigonometry to Determine Area</p> <p>Geometry M2 Lesson 32: Using Trigonometry to Find Side Lengths of an Acute Triangle</p> <p>Geometry M2 Lesson 33: Applying the Laws of Sines and Cosines</p> <p>Geometry M2 Lesson 34: Unknown Angles</p> <p>Precalculus and Advanced Topics M4 Lesson 8: Law of Sines</p> <p>Precalculus and Advanced Topics M4 Lesson 9: Law of Cosines</p> <p>Precalculus and Advanced Topics M4 Lesson 10: Putting the Law of Cosines and the Law of Sines to Use</p> <p><i>Supplemental material is necessary to address solving right triangle problems in context.</i></p>
<p>11-12.GM.4</p> <p>Derive the formula $A = \frac{1}{2}ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.</p>	<p>Geometry M2 Lesson 31: Using Trigonometry to Determine Area</p> <p>Precalculus and Advanced Topics M4 Lesson 7: An Area Formula for Triangles</p>

Data, Probability, and Statistics: Learners will ask and answer questions by collecting, organizing, and displaying relevant data, drawing inferences and conclusions, making predictions, and understanding and applying basic concepts of probability.

<p>North Dakota Mathematics K–12 Standards</p>	<p>Aligned Components of <i>Eureka Math</i></p>
<p>11-12.DPS.10</p> <p>Determine when the order in counting matters and use permutations and combinations to compute probabilities of events accordingly. Determine probability situations as conditional, “or” (union), or “and” (intersection), and determine the probability of an event.</p>	<p>Precalculus and Advanced Topics M5 Topic A: Probability</p>
<p>11-12.DPS.11</p> <p>Use permutations and combinations to compute probabilities of compound events and solve problems.</p>	<p>Precalculus and Advanced Topics M5 Lesson 4: Using Permutations and Combinations to Compute Probabilities</p>
<p>11-12.DPS.12</p> <p>Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space. Graph the corresponding probability distribution using the same graphical displays as for data distributions.</p>	<p>Precalculus and Advanced Topics M5 Lesson 5: Discrete Random Variables</p> <p>Precalculus and Advanced Topics M5 Lesson 6: Probability Distribution of a Discrete Random Variable</p> <p>Precalculus and Advanced Topics M5 Lesson 13: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 14: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 15: Using Expected Values to Compare Strategies</p>

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11-12.DPS.13</p> <p>Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.</p>	<p>Precalculus and Advanced Topics M5 Lesson 7: Expected Value of a Discrete Random Variable</p> <p>Precalculus and Advanced Topics M5 Lesson 8: Interpreting Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 13: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 14: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 15: Using Expected Values to Compare Strategies</p>
<p>11-12.DPS.14</p> <p>Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.</p> <ol style="list-style-type: none"> Find the expected payoff for a game of chance. Evaluate and compare strategies on the basis of expected values. 	<p>Precalculus and Advanced Topics M5 Lesson 13: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 14: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 15: Using Expected Values to Compare Strategies</p>
<p>11-12.DPS.15</p> <p>Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities are calculated; find the expected value.</p>	<p>Precalculus and Advanced Topics M5 Lesson 9: Determining Discrete Probability Distributions</p> <p>Precalculus and Advanced Topics M5 Lesson 10: Determining Discrete Probability Distributions</p> <p>Precalculus and Advanced Topics M5 Lesson 13: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 14: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 15: Using Expected Values to Compare Strategies</p>

**North Dakota Mathematics
K–12 Standards**

Aligned Components of *Eureka Math*

<p>11-12.DPS.16</p> <p>Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value.</p>	<p>Precalculus and Advanced Topics M5 Lesson 11: Estimating Probability Distributions Empirically</p> <p>Precalculus and Advanced Topics M5 Lesson 12: Estimating Probability Distributions Empirically</p> <p>Precalculus and Advanced Topics M5 Lesson 13: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 14: Games of Chance and Expected Value</p> <p>Precalculus and Advanced Topics M5 Lesson 15: Using Expected Values to Compare Strategies</p>
<p>11-12.DPS.17</p> <p>Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).</p>	<p>Precalculus and Advanced Topics M5 Lesson 16: Making Fair Decisions</p> <p>Precalculus and Advanced Topics M5 Lesson 17: Fair Games</p>
<p>11-12.DPS.18</p> <p>Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).</p>	<p>Precalculus and Advanced Topics M5 Lesson 15: Using Expected Values to Compare Strategies</p> <p>Precalculus and Advanced Topics M5 Lesson 18: Analyzing Decisions and Strategies Using Probability</p> <p>Precalculus and Advanced Topics M5 Lesson 19: Analyzing Decisions and Strategies Using Probability</p>