VERNON TOWNSHIP
SCHOOL DISTRICT

Precalculus ACP
Curriculum Map

Adapted from:
Understanding By Design

Reviewed by:
Dr. Charles McKay

Adopted:
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Course Description

Pre-Calculus completes the formal study of the elementary functions that begin in Algebra I ACP and Algebra II ACP. This course addresses topics in algebraic, geometric and logical approaches. This course is offered to students who have successfully completed Algebra II ACP. Students focus on the use of technology, modeling and problem solving involving data analysis, trigonometric and circular functions, their inverses, polar coordinates, complex numbers, vectors, exponential and logarithmic functions. Word problems and real-life applications are utilized to help make mathematics meaningful and enjoyable to students. Graphing calculators are used extensively to aid students in navigating through modeling, data analysis and problem solving.

Prerequisites: Successful completion of Algebra II ACP with a minimum grade of 75%.

Based upon the following list of proficiencies, each student must demonstrate a minimum competency level of 65%. Competencies will be measured by way of an evaluation program consisting of teacher observations of student performance, tests, quizzes, classwork, homework, projects, and class participation, as well as class attendance in accordance with the high school's attendance policy.

Successful completion of this course earns 5 credits toward graduation.

Various Levels of Text:
Supplemental text and audio visual materials are provided for above grade level and below grade level for students who need them.
AI tools and Text to Speech tools may be used to adapt the lexile level of grade level materials.

- HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
- HSN-RN.A.3 Simplify radicals, including algebraic radicals
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
- HSN-CN.A.1 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.
- HSN-CN.A.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
- HSN-CN.A.3 Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

- HSN-CN.B.4 Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.
- HSN-CN.B.5 Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.
- HSN-CN.B.6 Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.
- HSN-CN.C.7 Solve quadratic equations with real coefficients that have complex solutions.
- HSN-CN.C.8 Extend polynomial identities to the complex numbers.
- HSN-CN.C.9 Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
- HSN-VM.A.1 Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $|\boldsymbol{v}|$, $\|\boldsymbol{v}\|$, v).
- HSN-VM.A.2 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
- HSN-VM.A.3 Solve problems involving velocity and other quantities that can be represented by vectors.
- HSN-VM.B.4 Add and subtract vectors.
- HSN-VM.B.5 Multiply a vector by a scalar.
- HSN-VM.C.6 Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
- HSN-VM.C.7 Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
- HSN-VM.C.8 Add, subtract, and multiply matrices of appropriate dimensions.
- HSN-VM.C.9 Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
- HSN-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.
- HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
- HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it. For example, see x4– y4 as (x2)2– (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2+ y2).
- HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

- HSA-SSE.B.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.
- HSA-APR.A.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
- HSA-APR.B.2 Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x – a$ is $p(a)$, so $p(a) = 0$ if and only if $(x – a)$ is a factor of $p(x)$.
- HSA-APR.B.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
- HSA-APR.C.5 Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.
- HSA-APR.D.6 Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
- HSA-APR.D.7 Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
- HSA-REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- HSA-REI.B.4 Solve quadratic equations in one variable.
- HSA-REI.C.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- HSA-REI.C.6 Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.
- HSA-REI.C.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = –3x and the circle x2 + y2= 3.
- HSA-REI.C.8 Represent a system of linear equations as a single matrix equation in a vector variable.
- HSA-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).

- HSA-REI-D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- HSA-REI-D.11 Explain why the x-coordinates of the points where the graphs of the equations y= f(x) and y= g(x) intersect are the solutions of the equation f(x) = g(x)
- HSA-REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
- HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- HSF-IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.
- HSF-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- HSF-IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- HSF-IF.B.6Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- HSF-IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
- HSF-BF.A.1 Write a function that describes a relationship between two quantities.

- HSF-BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
- HSF-BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.
- HSF-BF.B.4 Find inverse functions.
- HSF-BF.B.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
- HSF-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
- HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- HSF-LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- HSF-LE.A.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where b, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
- HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.
- HSF-TF.A.1 Understand the radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- HSF-TF.A.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
- HSF-TF.A.3 Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and 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.
- HSF-TF.A.4 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
- HSF-TF.B.6 Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
- HSF-TF.B.7 Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

- HSF-TF.C.8 Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.
- HSF-TF.C.9 Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.
- HSG-SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- HSG-GPE.A.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- HSG-GPE.B.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
- HSG-GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
- HSG-GPE.B.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
- HSG-CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
- HSG-SRT.C.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
- HSG-SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles.
- HSG-SRT.D.9 Derive the formula $A = 1/2\ ab\ \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
- HSG-SRT.D.10 Prove the Laws of Sines and Cosines and use them to solve problems.
- HSG-SRT.D.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).
- HSG-GPE.A.2 Derive the equation of a parabola given a focus and directrix.
- HSG-GPE.A.3 Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
- HSG-GMD.B.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
- HSG-C.A.4 Construct a tangent line from a point outside a given circle to the circle.

- HSS-ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
- HSS-CP.B.9 Use permutations and combinations to compute probabilities of compound events and solve problems.
- HSS-IC.A.2- Decide if a specified model is consistent with results from a given data-generating process
- HSS-IC.B.3- Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- HSS-CP.A.1- Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
- HSS-CP.B.8- Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.

New Jersey learning Standards covered throughout the course

In conjunction with the New Jersey Student Learning Standards, students enrolled in the **Precalculus ACP** courses will demonstrate the ability to:

Grading Criteria

- Homework - 10%
- Quizzes - 30%
- Tests -50%
- Participation - 10%

Course Resources

Text:

- Precalculus 5e, Pearson, Blitzer, 2014

Technologies

- Personal computer with Internet access, a web browser and word processing, presentation software for both teacher and student use
- Software and web-based presentation resources

Supplemental Materials

- Learning Plans/Schoology
- Worksheets

- Extra Practice
- Homework
- Projects

Scope and Sequence- Topical Outline		
Unit	Title	Time
1	Prerequisites for Precalculus	10 Days
2	Functions & Graphs	14 Days
3	Polynomials and Rational Functions	14 Days
4	Exponential & Logarithmic Functions	12 Days
5	Trigonometric Functions	18 Days
6	Analytic Trigonometry	16 Days
7	Additional Topics in Trigonometry	12 Days
8	Systems of Equations and Inequalities	15 Days
9	Matrices & Determinants	18 Days
10	Sequences, Induction, & Probability	12 Days
11	Introduction to Calculus	14 Days

The timeline is only an approximation. The inclusion of a classroom project in any one of the above units would extend the time allotment.

Subject Area: Math **Grade Level: Precalculus ACP**	
Unit	**1 Prerequisites for Precalculus**
Timeframe	10 Days

Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. • HSN-RN.A.3 Simplify radicals, including algebraic radicals. • HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. • HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. • HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. • HSA-APR.D.7 Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. • HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
Essential Questions	• How do we solve an unfamiliar equation? • How do we know if an expression is completely simplified? • Besides checking our work, what are some strategies to help us gain confidence that we are solving a problem correctly?
Content Knowledge/ Skills	*Students will learn and be able to:* • Evaluate algebraic expressions • Use mathematical models

	• Find the intersection of two sets • Find the union of two sets • Recognize subsets of the real numbers • Use inequality symbols • Evaluate absolute value • Use absolute value to express distance • Identity properties of the real numbers • Simplify algebraic expressions • Use properties of exponents • Simplify exponential expressions • Use scientific notation • Evaluate square roots • Simplify square roots • Perform operations with radicals • Rationalize denominators • Use rational exponents • Understand the vocabulary of polynomials • Add and subtract polynomials • Multiply polynomials • Use FOIL in multiplication of polynomials • Use special products of polynomials • Perform operations with polynomials • Factor polynomials with integer exponents • Factor polynomials with fractional and negative exponents • Specify excluded values from the domain • Perform operations with rationals • Simplify rational expressions that occur in calculus • Solve linear equations • Solve rational equations • Solve literal equations for a variable • Solve absolute value equations

	• Solve quadratic equations • Solve radical equations • Use equations to solve problems • Use interval notation • Find intersections and unions of intervals • Solve linear inequalities • Solve compound inequalities
Performance Tasks	• Quizzes • Chapter Assessments • Midterms/Finals
Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level: Precalculus ACP**	
Unit	**2 Functions & Graphs**

Timeframe	14 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. • HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$. • HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. • HSF-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. • HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. • HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. • HSF-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. • HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). • HSF-BF.A.1 Write a function that describes a relationship between two quantities. • HSF-BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

	• HSF-BF.B.4 Find inverse functions. • HSF-BF.B.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. • HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. • HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. • HSG-GPE.A.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. • HSG-GPE.B.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). • HSG-GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio. • HSG-GPE.B.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
Essential Questions	• How does a graph convey information about the function or relation it represents? • How can mathematical ideas be represented? • How are symbols useful in mathematics? • How do the functions used in a composite of functions affect the graph of the composite?
Content Knowledge/ Skills	*Students will learn and be able to:* • Graph points and equations on a rectangular coordinate system • Find intercepts using a graph • Interpret information about a graph • Find domain and range of a function • Determine if a relation is a function • Evaluate a function

	• Graph functions by plotting points • Identify intercepts from a function's graph • Identify intervals on which a function increases, decreases, or is constant • Locate relative maximum and minimum points • Identify even and odd functions • Understand and use piecewise functions • Find and simplify a function's difference quotient • Write and graph lines using slope-intercept, point-slope, and standard form • Model data with linear functions and make predictions • Find slopes and equations of parallel and perpendicular lines • Interpret slope as rate of change • Find a function's average rate of change • Recognize parent functions • Use reflections, translations, and dilations to transform parent function • Transform parent functions using a composition of transformations • Find the domain of a function • Combine functions using algebra • Form composite functions • Determine domains for composite functions • Write functions as compositions • Verify inverse functions • Find the inverse functions • Use the horizontal line test • Use a graph of a function to graph its inverse • Find the distance between two points • Find the midpoint of a line segment • Write the standard form of a circle • Give the center and radius of a circle in standard form

	• Convert the general form of a circle's equation to standard form • Construct functions from verbal descriptions • Construct functions from equations
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals
Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level:Precalculus ACP**	
Unit	**3 Polynomial & Rational Functions**
Timeframe	14 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSN-CN.A.1 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. • HSN-CN.A.2 Use the relation $i^2 = –1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. • HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. • HSA-REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. • HSA-REI.B.4 Solve quadratic equations in one variable. • HSA-APR.B.2 Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x – a$ is $p(a)$, so $p(a) = 0$ if and only if $(x – a)$ is a factor of $p(x)$. • HSA-APR.B.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. • HSA-APR.D.6 Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system. • HSA-APR.D.7 Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. • HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

	• HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. • HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. • HSF-IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
Essential Questions	• How can we confirm the zeros (where the graph crosses the xaxis) and the number of turning points by using a graphing calculator to graph the polynomial function? • What are the characteristics of power, radical, polynomial, and rational functions? • What does the remainder as the result of dividing polynomials tell us? • How can representing the same mathematical relationship in different ways be helpful? • Why would it be helpful to replace an expression with an equivalent expression?
Content Knowledge/ Skills	*Students will learn and be able to:* • Perform operations with complex numbers • Solve quadratic equations complex solutions • Recognize characteristics and graph parabolas • Determine a quadratic function's max/min value • Solve problems involving quadratic functions • Identify and graph polynomial functions • Recognize characteristics of polynomial functions, including end behavior • Identify zeros and their multiplicity • Use Intermediate Value Theorem • Understand the relationship between degree and turning points • Divide Polynomials • Evaluate a polynomial using Remainder Theorem • Use the Factor Theorem to solve a polynomial • Use Rational Zero Theorem to find possible zeros • Find zeros of a polynomial • Solve polynomial equations • Use Linear factorization theorem to find polynomials with given zeros • Use Descarte's Rule of Signs • Find the domain and range of rational functions

	• Use arrow notation • Identify horizontal and vertical asymptotes • Use transformations to graph rational equations • Graph rational functions • Identify slant asymptotes • Solve applied problems involving rational functions • Solve polynomial inequalities • Solve rational inequalities • Solve problems modeled by polynomial or rational inequalities • Solve direct variation problems • Solve inverse variation problems • Solve combined variation problems • Solve joint variation problems
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals
Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math Grade Level:Precalculus ACP	
Unit	**4 Exponential & Logarithmic Functions**
Timeframe	12 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. • HSF-IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. • HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). • HSF-LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. • HSF-LE.A.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where b, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology. • HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context. • HSF-BF.B.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
Essential Questions	• What real-world situations are represented by exponential growth or decay functions? • How can logarithms represent real-world situations?

Content Knowledge/ Skills	*Students will learn and be able to:* ● Evaluate exponential functions ● Graph exponential functions ● Evaluate functions with base e ● Use compound interest formulas ● Change forms between logarithmic and exponential forms ● Evaluate logarithms ● Use basic logarithmic properties ● Graph logarithmic functions ● Find the domain of a logarithmic function ● Use common and natural logarithms ● Use product, quotient, and power rules ● Expand and condense logarithmic expressions ● Use the change-of-base property ● Solve exponential and logarithmic equations ● Model exponential growth and decay ● Use logistic growth models ● Use Newton's Law of Cooling ● Choose an appropriate model for data ● Express an exponential model in base e.
Performance Tasks	● Quizzes ● Chapter Assessments ● Link It Benchmarks A-C ● Midterms/Finals
Other Assessment Evidence	● Warm up/Problem of the Day ● Pre-Assessments ● Lesson ● Classwork/Guided Practice ● Independent Practice/Classwork/Homework ● Check for Understanding/In class Independent Practice/Homework

Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level:Precalculus ACP**	
Unit	**5 Trigonometric Functions**
Timeframe	18 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSF-TF.A.1 Understand the radian measure of an angle as the length of the arc on the unit circle subtended by the angle. • HSF-TF.A.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

	• HSF-TF.A.3 Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and 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. • HSF-TF.A.4 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. • HSF-TF.B.6 Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. • HSF-TF.B.7 Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context. • HSG-SRT.C.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. • HSG-SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles. • HSG-SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. • HSG-C.A.4 Construct a tangent line from a point outside a given circle to the circle.
Essential Questions	• What is the relationship between the angles and the side lengths of a triangle? • How can trigonometric functions be applied in real life? • How do the graphs of the trigonometric functions model periodic functions in real life?
Content Knowledge/ Skills	*Students will be able to:* • Recognize and use vocab of angles • Use degree and radian measures and convert between the two • Draw an angle in standard position • Find coterminal angles • Find the length of an arc of a circle • Use linear and angular speed to motion on a circular path • Use a unit circle to define trigonometric functions of real numbers • Recognize domain and range of sine and cosine functions • Find exact value of trigonometric functions at pi/4 • Use even and odd trig functions • Recognize and use fundamental identities

	• Use periodic properties • Evaluate trig functions with a calculator • Use special right triangles to evaluate trig functions • Use equal cofunctions of complements • Use right triangle trig to solve applied problems • Use the definition of trig functions of any angles • Use the signs of trig functions • Find reference angles • Use reference angles to evaluate trig functions • Understand the graphs of y=sinx and y=cosx • Transform the parent functions, including the period • Understand the graphs of y=tanx, y=cotx, y=secx, y=cscx • Transform the parent functions, including the period • Understand and use inverse, sine, cosine, and tangent functions • Use a calculator to evaluate inverse trig functions • Find the exact values of composite functions with inverse trig functions • Solve a right triangle • Solve problems involving bearings • Model simple harmonic motion
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals
Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework

	• Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level:Precalculus ACP**	
Unit	**6 Analytic Trigonometry**
Timeframe	16 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSA-REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. • HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. • HSF-TF.C.8 Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle. • HSF-TF.C.9 Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems

Essential Questions	• How can representing the same mathematical relationship in different ways be helpful? • Why would it be helpful to replace an expression with an equivalent expression? • How many solutions are there for a trig equation?
Content Knowledge/ Skills	*Students will learn and be able to:* • Use trig identities to verify identities • Use the sum and difference formulas for sine, cosine, and tangent • Use the double angle formula • Use the half angle formula • Use the power reducing formula • Use the product-to-sum and the sum-to-product formulas • Find all the solutions of a trig equation • Solve equations with multiple angles • Solve trig equations in quadratic form • Use factoring to separate different functions in trig equations • Use identities to solve trig equations • Use a calculator to solve trig equations
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals
Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science

Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level:Precalculus ACP**	
Unit	**7 Additional Topics in Trigonometry**
Timeframe	12 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSN-CN.A.1 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. • HSN-CN.A.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. • HSN-CN.A.3 Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. • HSN-CN.B.4 Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number. • HSN-CN.B.5 Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. • HSN-CN.B.6 Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

	• HSN-CN.C.7 Solve quadratic equations with real coefficients that have complex solutions. • HSN-CN.C.8 Extend polynomial identities to the complex numbers. • HSN-CN.C.9 Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. • HSN-VM.A.1 Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $\|\boldsymbol{v}\|$, $\|\boldsymbol{v}\|$, v). • HSN-VM.A.2 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. • HSN-VM.A.3 Solve problems involving velocity and other quantities that can be represented by vectors. • HSN-VM.B.4 Add and subtract vectors. • HSG-SRT.D.9 Derive the formula $A = 1/2\ ab\ \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. • HSG-SRT.D.10 Prove the Laws of Sines and Cosines and use them to solve problems. • HSG-SRT.D.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).
Essential Questions	• What kinds of quantities/measurements inherently associate with direction, and what kinds do not? • How is traveling in a fixed medium (e.g. car on a road) different from traveling in a variable medium (e.g. plane in the air, ship in the water)?
Content Knowledge/ Skills	*Students will learn and be able to:* • Use Law of Sines to solve triangles, if possible, or triangles in the ambiguous case • Find the area of a triangle using sine • Solve applied problems using Law of Sines • Use Law of Cosines to solve triangles • Use Law of Cosines to solve applied problems • Use Heron's formula to find the area of a triangle • Plot points in the polar coordinate system • Find multiple sets of polar coordinates for a given point

	• Convert a point between rectangular coordinates and polar coordinates • Convert an equation between rectangular coordinates and polar coordinates • Use point plotting to graph polar equations • Use symmetry to graph polar equations • Plot complex numbers in the complex plane • Find the absolute value of a complex number • Write complex numbers in polar form • Convert a complex number from polar to rectangular form • Find the product, powers, roots, and quotient of complex numbers in polar form • Use magnitude and direction to show vectors are congruent • Visualize scalar multiplication, vector addition, and vector subtraction as geometric vectors • Represent vectors in the rectangular coordinate system • Perform operations on vectors in terms of i and j • Find the unit vector in the direction on v • Write vectors in terms of its magnitude and direction • Solve applied problems involving vectors • Find the dot product of two vectors • FInd the angle between two vectors • Use the dot product to determine if two vectors are orthogonal
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals
Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links

Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level: Precalculus ACP**	
Unit	**8 Systems of Equations & Inequalities**
Timeframe	15 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSA-REI.C.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. • HSA-REI.C.6 Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables. • HSA-REI.C.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = –3x$ and the circle $x_2 + y_2 = 3$.. • HSA-REI-D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

	• HSA-REI-D.11 Explain why the x-coordinates of the points where the graphs of the equations y= f(x) and y= g(x) intersect are the solutions of the equation f(x) = g(x) • HSA-REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. • HSA-APR.D.6 Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system. • HSA-APR.D.7 Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. • HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
Essential Questions	• What does a solution to a system of equations mean in terms of the equations? • How does solving a system of nonlinear equations differ from a system of equations?
Content Knowledge/ Skills	*Students will learn and be able to:* • Solve problems involving systems of linear equations • Solve problems using systems in three variables • Decompose using P/Q • Solve problems involving systems of nonlinear equations • Graph a system of inequalities, using both linear and nonlinear inequalities • Write an objective function describing a quantity that must be maximized or minimized • Use linear programming to solve problems
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals

Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level: Precalculus ACP**	
Unit	**9 Matrices & Determinants**
Timeframe	18 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSN-VM.C.6 Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

	• HSN-VM.C.7 Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. • HSN-VM.C.8 Add, subtract, and multiply matrices of appropriate dimensions. • HSN-VM.C.9 Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties. • HSN-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. • HSA-REI.C.8 Represent a system of linear equations as a single matrix equation in a vector variable. • HSA-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).
Essential Questions	• How can matrices be used to help solve linear systems?
Content Knowledge/ Skills	*Students will be able to:* • Write the augmented matrix for a linear system • Use matrix row operations to solve systems • Solve problems involving systems without unique solutions • Use matrix notation • Understand what is meant by equal matrices • Perform operations on matrices • Model applied situations with matrix operations • Find multiplicative inverse of a square matrix • Use inverses to solve matrix equations • Encode and decode messages • Evaluate a determinant • Solve a system of equations using Cramer's Rule
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals

Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level:Precalculus ACP**	
Unit	**10 Sequences, Induction, & Probability**
Timeframe	12 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.

NJSLS	• HSA-APR.C.5 Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle. • HSA-SSE.B.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. • HSF-IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. • HSF-BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. • HSS-ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. • HSS-IC.A.2- Decide if a specified model is consistent with results from a given data-generating process • HSS-IC.B.3- Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. • HSS-CP.A.1- Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). • HSS-CP.B.8- Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. • HSS-CP.B.9 Use permutations and combinations to compute probabilities of compound events and solve problems.
Essential Questions	• How can you effectively evaluate information? • How can you use information to make decisions? • How does the probability change when an and statement is changed to an or statement? • How do the terms in a geometric series differ from an arithmetic series?
Content Knowledge/ Skills	*Students will be able to:* • Find particular terms of a sequence from the general term • Use recursive formulas • Use factorial notation

	• Use summation notation • Find the common difference of an arithmetic sequence • Write terms of an arithmetic sequence • Use formula for the general term of an arithmetic sequence • Use the formula for the sum of the first n terms of an arithmetic sequence • Find the common ratio of a geometric sequence • Write terms of a geometric sequence • Use the formula for the general term of a geometric sequence • Use the formula for the first n terms of a geometric sequence • Find the value of an annuity • Use the formula for the sum of an infinite geometric series • Understand the principle of mathematical induction • Prove statements using geometric induction • Evaluate a binomial coefficient • Expand a binomial raised to a power • Find a particular term in a binomial expansion • Use the Fundamental Counting Principle • Use the permutation formula • Distinguish between permutation and combination problems • Use the combination formula • Compute empirical probability • Compute theoretical probability • Find the probability that an event will not occur • Find the probability of one event or a second event occurring • Find the probability of one event and a second event occurring
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals
Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice

	• Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math **Grade Level: Precalculus ACP**	
Unit	**11 Introduction to Calculus**
Timeframe	14 Days
Established Goals	• MP.1 Make sense of problems and persevere in solving them. • MP.2 Reason abstractly and quantitatively. • MP.3 Construct viable arguments & 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.
NJSLS	• HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. • HSF-IF.B.6Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

	• HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
Essential Questions	• How is it possible to find the value of a function as it reaches a disconituity? • What is the difference between the average velocity and instantaneous velocity and how do you find each? • What does the area under a velocity curve represent and how can it be found (both approximately and exactly)?
Content Knowledge/ Skills	*Students will be able to:* • Understand limit notation • Find limits using tables find limits using graphs • Find one-sided limits and use them to determine if a limit exists • Find limits of constant functions and identify the function • Find limits using properties of limits • Find one-sided limits using properties of limits • Find limits of fractional expressions in which the limit of the denominator is zero • Determine if a function is continuous at a number Determine for what numbers a function is discontinuous • Find slopes and equations of tangent lines • Find the derivative of a function • Find average and instantaneous rates of change • Find instantaneous velocity • Find area under a curve using approximation • Find area under a curve using Geometry • Find the antiderivative of a function • Identify similarities and differences between derivatives and integrals • Find total shaded area on a graph using antiderivatives
Performance Tasks	• Quizzes • Chapter Assessments • Link It Benchmarks A-C • Midterms/Finals

Other Assessment Evidence	• Warm up/Problem of the Day • Pre-Assessments • Lesson • Classwork/Guided Practice • Independent Practice/Classwork/Homework • Check for Understanding/In class Independent Practice/Homework
Resources/Materials	• Student Edition • Extra Practice Homework • Schoology Links
Interdisciplinary Connections	• Language Arts • Science
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework

Career Readiness, Life Literacies, and Key Skills	• 9.1.12.CFR.1: Compare and contrast the role of philanthropy, volunteer service, and charities in community development and quality of life in a variety of cultures. • 9.1.12.CFR.2: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions. • 9.1.12.CFR.3: Research companies with corporate governance policies supporting the common good and human rights. • 9.1.12.CFR.4: Demonstrate an understanding of the interrelationships among attitudes, assumptions, and patterns of behavior regarding money, saving, investing, and work across cultures. • 9.1.12.CFR.5: Summarize the purpose and importance of estate planning documents (e.g., will, durable power of attorney, living will, health care proxy, etc.). • 9.1.12.CFR.6: Identify and explain the consequences of breaking federal and/or state employment or financial laws. • 9.1.12.CDM.1: Identify the purposes, advantages, and disadvantages of debt. • 9.1.12.CDM.2: Compare and contrast the advantages and disadvantages of various types of mortgages. • 9.1.12.CDM.3: Determine ways to leverage debt beneficially.

	• 9.1.12.CDM.4: Identify issues associated with student loan debt, requirements for repayment, and consequences of failure to repay student loan debt. • 9.1.12.CDM.5: Identify the types of characteristics of predatory lending practices and the importance of collateral (e.g., payday loans, car title loans, high-risk mortgages). • 9.1.12.CDM.6: Compute and assess the accumulating effect of interest paid over time when using a variety of sources of credit. (e.g., student loans, credit cards, auto loans, mortgages, etc.). • 9.1.12.CDM.7: Calculate a mortgage payment based on type of loan, down payment, credit score, and loan interest rate. • 9.1.12.CDM.8: Compare and compute interest and compound interest and develop an amortization table using business tools. • 9.1.12.CDM.9: Summarize the causes and consequences of personal and corporate bankruptcy and evaluate the implications for self and others. • 9.1.12.CDM.10: Determine when credit counseling is necessary and evaluate the resources available to assist consumers who wish to use it. • 9.1.12.CP.1: Summarize how one's credit history can affect finances, including loan terms, employment, and qualifying for loans. • 9.1.12.CP.2: Identify the advantages of maintaining a positive credit history. • 9.1.12.CP.3: Summarize factors that affect a positive credit rating, including on-time payments, debt versus available credit, length of open credit, and how often you apply for credit. • 9.1.12.CP.4: Identify the skill sets needed to build and maintain a positive credit profile. • 9.1.12.CP.5: Create a plan to improve and maintain an excellent credit rating. • 9.1.12.CP.6: Explain the effect of debt on a person's net worth. • 9.1.12.CP.7: Summarize factors that affect a particular credit scoring system. • 9.1.12.CP.8: Identify different ways you can protect your credit. • 9.1.12.CP.9: Analyze the information contained in a credit report, how scores are calculated and used, and explain the importance of disputing inaccurate entries. • 9.1.12.EG.1: Review the tax rates on different sources of income and on different types of products and services purchased. • 9.1.12.EG.2: Explain why various forms of income are taxed differently. • 9.1.12.EG.3: Explain how individuals and businesses influence government policies. • 9.1.12.EG.4: Explain the relationship between your personal financial situation and the broader economic and governmental policies. • 9.1.12.EG.5: Relate a country's economic system of production and consumption to building personal wealth, the mindset of social comparison, and achieving societal responsibilities.

	• 9.1.12.EG.6: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws. • 9.1.12.FI.1: Identify ways to protect yourself from identify theft • 9.1.12.FI.2: Explain ways to manage your accounts that maximize benefits and provide you with the utmost protection. • 9.1.12.FI.3: Develop a plan that uses the services of various financial institutions to prepare for long term personal and family goals (e.g., college, retirement). • 9.1.12.FI.4: Research benefits and drawbacks of products offered by financial and non-financial companies (e.g., banks, credit unions, check-cashing stores, product warranty insurance). • 9.1.12.FP.1: Create a clear long-term financial plan to ensure its alignment with your values. • 9.1.12.FP.2: Explain how an individual's financial values and goals may change across a lifetime and the adjustments to the personal financial plan that may be needed. • 9.1.12.FP.3: Relate the concept of delayed gratification (i.e., psychological distance) to meeting financial goals, investing and building wealth over time. • 9.1.12.FP.4: Identify how unconscious beliefs like "money scripts" (money avoidant, money worship, money status, money vigilant) influence financial decision-making. • 9.1.12.FP.5: Evaluate how behavioral bias (e.g., overconfidence, confirmation, recency, loss aversion, etc.) affects decision-making. • 9.1.12.FP.6: Evaluate the relationship of familial patterns, cultural traditions, and historical influences on financial practice. • 9.1.12.FP.7: Determine how multiple sources of objective, accurate and current financial information affect the prioritization of financial decisions (e.g., print information, prospectus, certified financial planners, internet, sales representatives, etc.). • 9.1.12.PB.1: Explain the difference between saving and investing. • 9.1.12.PB.2: Prioritize financial decisions by considering alternatives and possible consequences. • 9.1.12.PB.3: Design a personal budget that will help you reach your long-term and short-term financial goals. • 9.1.12.PB.4: Explain how you would revise your budget to accommodate changing circumstances. • 9.1.12.PB.5: Analyze how changes in taxes, inflation, and personal circumstances can affect a personal budget. • 9.1.12.PB.6: Describe and calculate interest and fees that are applied to various forms of spending, debt and saving. • 9.1.12.RM.1: Describe the importance of various sources of income in retirement, including Social Security, employer-sponsored retirement savings plans, and personal investments. • 9.1.12.RM.2: Identify types of investments appropriate for different objectives such as liquidity, income, and growth. • 9.1.12.RM.3: Compare the cost of various types of insurance (e.g., life, homeowners, motor vehicle) for the same product or service, strategies to lower costs, and the process for filing an insurance claim.

	• 9.1.12.RM.4: Determine when and why it may be appropriate for the government to provide insurance coverage rather than private industry. • 9.1.12.RM.5: Explain what self-insuring is and determine when it is appropriate. • 9.1.12.RM.6: Differentiate the costs benefits and features (e.g., riders, deductibles, umbrella policies) of renter's and homeowner's insurance. • 9.1.12.RM.7: Evaluate individual and family needs for insurance protection using opportunity -cost analysis to determine if the amount of protection is adequate or over -insured. • All Career Readiness, Life Literacies, and Key Skills • Our CTE offerings are extensive at the HS level. Currently, we offer 8 CTE programs at Vernon Township High School including: Engineering, Hospitality, Allied Health, Marketing, Construction, Computer Science, Cosmetology, and Graphic Design. • ARTSTANDING is a district-wide event that allows all "Special" areas to be highlighted -- of which CTE programs and Career Pathways are included.
Use of Technology	• Course catalog includes CTE programs such as Engineering, Computer Science, and Graphic Arts to provide technological opportunities to prepare for careers • All students are one-to-one with Chromebooks for day-to-day use in the classroom • All students log onto computers where they utilize a variety of instructional and online tools to enhance their classroom instruction as well as aid in the problem solving process • Many of the concepts that are explored in the high school mathematics curriculum involve solving problems using a step by step process and are eventually summarized using and algorithm • All classrooms have access to an interactive Smart Board with speaker system so lessons can include video, sound, and interactive lessons for all learners
Technology Integration	• TECH.8.1.8 All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. • TECH.8.1.8.A.CS1 Understand and use technology systems. • TECH.8.1.8.A.CS2 Select and use applications effectively and productively. • TECH.8.1.8.C Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. • TECH.8.1.8.C.CS1 Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media. • TECH.8.1.8.F Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. • TECH 8.2.12.D.1 Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review • TECH 8.1.12.A.2 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related are for review

	• TECH 8.1.12.A.CS2 Select and use applications effectively and productively
Differentiation and Accommodations for: Special Education	• Accommodations will be dictated by the general makeup of the class. • Special Education modifications will be implemented as per the Individualized Education Programs of the students in the class. • Please click here for an overview of the variety of accommodations set in place.
English Language Learners	• Coordinate activities with ESL teacher to accommodate individual learning needs • Provide appropriate leveled texts • Students complete the ACCESS 2.0 test yearly to measure growth and guide instruction
Risk for School-Failure	• Credit Retrieval Programs • Apex - virtual • Viking Success Academy • Counseling interventions • Parent meetings • Student meetings • Individual and Group counseling
Gifted and Talented Learners	• Inclusive Identification process that depicts the child as a whole in order to provide the best learning environment possible for each student. Click here for Identification Profile Sample • Tiered Services utilizing NAGC K-12 Programming standards to ensure individual needs are being met. Click here for services map. • Formative Assessment utilized in order to promote acceleration, curriculum compacting, grouping, and asynchronous learning where appropriate. • Dynamic Model for Gifted Program Improvement is utilized in order to verify that our program is employing not only up to date methods, but also effective ones. • Teacher training in Gifted Education.