

Pascack Valley Regional High School District

**Pascack Hills High School, Montvale, New Jersey
Pascack Valley High School, Hillsdale, New Jersey**

Course Name: AP Precalculus

Born On: August, 2016
Previous Revision: August, 2020
Current Revision: August, 2023
Board Approval: 8/28/23

Course Description:

AP Precalculus is a full year, five-credit course in pre-college mathematics. Students integrate concepts and skills acquired in prior algebra and geometry courses in a study of functions. Additional topics include analytic geometry, polar coordinates, sequences and series, counting theory, and probability. Students also begin the study of calculus through an introduction to limit theory. This course will prepare students for the Precalculus advanced placement examination. A student who satisfactorily completes the requirements of this course is prepared for a course in *Advanced Placement Calculus*, either AB or BC level.

All mathematics courses in the Pascack Valley Regional High School District are designed to address multiple learning styles and needs, and accommodations and modifications are made for students with disabilities, multilingual students, students at risk of failure, gifted and talented students, and students with 504 plans. *AP Precalculus* builds on concepts learned and skills developed in *Honors Algebra II w/ Trigonometry* and *Honors Geometry*, while also spiraling in those concepts and skills to reinforce and strengthen students' algebraic foundation. Additionally, *AP Precalculus* anticipates higher-level mathematics that will be learned in *AP Calculus* and beyond, and enrichment opportunities are provided to challenge students and engage them in rich, interesting mathematics. Students are encouraged to analyze data using tools and models to make valid and reliable claims (9.4.12.IML.3), and various technologies are integrated throughout the curriculum, including scientific calculators, graphing calculators, specialized software, and various Internet programs and subscriptions. These tools enrich the curriculum by giving students' access to additional mathematical representations, and they also help to differentiate by providing students with additional options to engage with mathematical tasks.

The Pascack Valley Regional High School Mathematics Department integrates 21st century life and career skills across its courses, with the dual goal of informing students about careers and fields of study that use mathematics (9.3.ST.5, 9.3.ST-ET.5 and 9.3.ST-SM.2), and helping students improve the quantitative, mathematical, and statistical reasoning skills they will need to be effective producers and consumers of quantitative information in their everyday lives (9.2.12.CAP.2). Mathematics courses address the *New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills*, with a particular emphasis on demonstrating the ability to reflect, analyze and use creative skills and ideas (9.4.12.CI.1), investigating new challenges and opportunities for personal growth, advancement and transition (9.4.12.CI.3), identifying problem-solving strategies used in the development of an innovative product or practice (9.4.12.CT.1), and explaining the potential benefits of collaborating to enhance critical thinking and problem solving (9.4.12.CT.2). Mathematics courses also address the *New Jersey Student Learning Standards for English Language Arts Companion Standards*, with a particular focus on following complex multistep procedures (RST.9-10.3/RST.11-12.3), determining the meaning of symbols, key terms, and other domain-specific words and phrases (RST.9-10.4/RST.11-12.3), and translating quantitative or technical information expressed in words into visual forms and translating information expressed visually or mathematically into words (RST.9-10.7). Similarly, the mathematics department seeks to support students by providing them with opportunities to use quantitative, statistical, and mathematical reasoning in interdisciplinary contexts, in contexts that are meaningful to students, and in contexts that attend to the contributions and perspectives of historically marginalized groups. Specifically, mathematics courses will look to incorporate, when appropriate, contributions and experiences of

people from the LGBTQ+ community and individuals with disabilities, and references to issues of social and cultural relevance, including climate change.

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Content/Topic:	Key Learning Items/Concepts and Pacing Guide	Observable Proficiencies and Skills:	NJSLS	Formative, Summative, Benchmark, and Alternative Assessments	Core Instructional and Supplemental Materials/ Modifications and Accommodations
<p>Unit 1 – Trigonometry</p> <p>Time: 13-15 weeks (<i>see column 2 for a more detailed breakdown</i>)</p>	<p>Key learning items/concepts:</p> <p>THE UNIT CIRCLE (TUC) TUC-2 Linear & Angular Speed, DMS (PWL 4.1 and AM 7-2) (2 days) - Arc Length and Sectors of Circles TUC-3 Evaluating Trigonometric Functions of Any Angle (PWL 4.2, 4.4, and AM 7-3 – 7-5) (3 days) - Angles in standard position, degrees and radians, value of the six trig functions for any angle TUC-4 The Unit Circle (PWL 4.2, 4.4, and AM 7-3 – 7-5) (3 days) TUC-5 Graphs of Trigonometric Functions (Sine and Cosine) (PWL 4.5 - 4.6 and AM 7-3 – 7-4) (3 days) - Graphs of all the Trigonometric Functions (PWL 4.5-4.6 and AM 8.2 – 8.3)</p>	<ul style="list-style-type: none"> - Measure angles in both degrees and radians easily translating from one to the other. - Identify the class of angles coterminal with a given angle in standard position. - Define an angle which measures one radian. - Find arc length and area of a sector and apply this to solving problems involving apparent size. - Derive arc length and area formulas. - Define the 6 trig functions. - Compare values of the sine (or cosine) of two angles w/o calculator. - Determine w/o calculators, exact values of the 6 trig functions for special angles. - Graph the 6 trig functions. - Utilize previous knowledge of translations and reflections to graph out-of-phase and shifted-sine and cosine functions. - Identify the name of a function whose graph is given—be able to name as either a sine or a cosine, a tangent or a cotangent. - Use knowledge of trig functions and their graphs to solve applied problems such as: tsunamis, Ferris wheel, pebble in the tire. 	<p>NJSLS Content Standards</p> <p>F-TF 1-9 G-C 5 G-SRT 6-11 F-BF 1-2 F-IF 4-6 N-CN 1, 4-6</p> <p>NJSLS SMP MP1. Make sense of problems and persevere in solving them MP2. Construct viable arguments and critique the reasoning of others</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Form A, B, or C benchmark (B) 	<p>Selection of primary sources <i>Suggestion(s)</i>: Texts: Precalculus with Limits, Larson, Hostetler, Edwards; Houghton Mifflin Company, 2008 (on grade level); Advanced Mathematics, Brown; Houghton Mifflin Company, 1994 (on grade level); Calculus with Analytic Geometry, Larson, Hostetler; D. C. Heath and Company, 1990 (advanced); Deltamath (remediation, on grade level, and advanced)</p> <p>Additional Resources:</p> <p><i>o The Basic Practice of Statistics, Moore; W. H. Freeman & Co</i> <i>o Precalculus with Trigonometry, Foerster; Key Curriculum Press</i> <i>o Exploring Precalculus with The Geometer’s Sketchpad, version 4, Scher, Kunkel, Lyublinskaya, and Steketee</i></p>

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	<ul style="list-style-type: none"> - Graphs including horizontal and vertical shifts in radians and degrees - Models and applications involving sine and cosine graphs - Writing Equations of Trigonometric Functions (PWL 4.5-4.6 and AM 8.2 – 8.3) TUC-6 The Inverse Trigonometric Functions (PWL 4.7 and AM 7-6) (2 days) <p>TRIANGLE TRIGONOMETRY (TT)</p> <p>TT-1 Right Triangle Trigonometry (PWL 4.3 and 4.8 and AM 9-1) (2 days)</p> <p>TT-2 The Area of an Oblique Triangle (PWL 6.1 and AM 9-2) (2 days)</p> <ul style="list-style-type: none"> - The area formula given 2 sides and the included angle. - Area of a segment and sector. <p>TT-3 The Law of Sines (PWL 6.1 AND AM 9-3) (2 days)</p> <p>TT-4 The Law of Cosines (PWL 6.2 AND AM 9-4) (2 days)</p> <ul style="list-style-type: none"> - Derivations of all formulas <p>TT-5 Applications of Law of Sines and Cosines (2 days)</p> <ul style="list-style-type: none"> - navigation, triangles and area of quadrilaterals <p>IDENTITIES & EQUATIONS</p>	<ul style="list-style-type: none"> - Determine the values of inverse trigonometric functions - Identify the domain and range of the inverse trig functions. - Determine values involving inverse trig functions with or w/o calculators. - Solve triangle problems involving right triangles using appropriate ratios including angle of elevation and angle of depression problems. - Determine the area of a segment of a circle. - Determine area of a triangle using two sides with the Sine of the included angle. - Determine area of quadrilaterals by triangulating. - Solve oblique triangles using Law of Sines and Law of Cosines. - Prove Law of Sines and Law of Cosines - Given a set of information, identify where Law of Sines or Law of Cosines applies. - Use calculators to their highest potential solving problems involving Law of Cosines. - Identify when the ambiguous case of the Law of Sines appears and describe how to determine whether the solution consists of 0,1, or 2 triangles. If two triangles, be able to defend the method of solving for the second triangle. - Convey, through example first, then theoretically justify why using the Law of Sines for solving a potential obtuse triangle can lead to incorrect answers. - Connect inverse trig functions to the explanation. 	<p>MP3. Reason abstractly and quantitatively</p> <p>MP4. Model with mathematics</p> <p>MP5. Attend to precision</p> <p>MP6. Use appropriate tools strategically</p> <p>MP7. Look for and make use of structure</p> <p>MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLS for ELA Companion Standards</p> <p>RST.9-10.3</p> <p>RST.9-10.4</p> <p>RST.9-10.7</p> <p>RST.11-12.3</p> <p>RST.11-12.4</p> <p>NJSLS-CLKS - 21st Century Life and Careers</p>	<ul style="list-style-type: none"> - alternative assessments (A) - Take home exams and investigations (F) - Bio Rhythm Project (S) - Weather Project (S) - The Unit Circle Activity (F) - Administration of previous AP exam sections and questions based on relevant topics (F) 	<p><i>o Exploring Calculus with The Geometer’s Sketchpad, version 4, Clements, Rantozzi and Steketee</i></p> <p><i>o Exploring Conics with The Geometers’ Sketchpad, Scher and Daniel</i></p> <p><i>o Conquering the New SAT Math, Postman and Postman</i></p> <p><i>o Grapher</i></p> <p><i>o Geometer’s Sketchpad</i></p> <p><i>o Calculus-in-Motion</i></p> <p><i>o TI-83/TI-84 graphing calculator</i></p> <p>Calculators: The TI-83, TI-83+, or TI-84 graphing calculators</p> <p>Modifications and Accommodations:</p> <p>Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students’ IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning.</p> <p>Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in</p>
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	<p>TIE-1 Simplifying and Verifying Trigonometric Identities (PWL 5.1 – 5.2 AND AM 8-4) (3 days) TIE-2 Simple Trigonometric Equations (PWL 5.3 AND AM 8.1, 8.5) (2 days) TIE-3 More Difficult Trigonometric Equations (PWL 5.3 AND AM 8.5) (3 days) - Solving trig equations involving multiple angles (PWL 5.4-5.5 and AM 10-4) TIE-4 Applications of Trigonometric Equations (AM 8.1) (2 days) - Angle of inclination and the angle between two lines.</p> <p>TRIGONOMETRIC ADDITION FORMULAS (TAF) TAF-1 Sum and Difference Formulas (PWL 5-4 and AM 10.1 – 10.2) (2 days) TAF-2 Double Angle Formulas & Half-Angle Formulas (PWL 5.5 and AM 10.3) (2 days) TAF-3 Trigonometric Equations with Double Angles (PWL 5.4-5.5 and AM 10-4) (3 days) - Derivations of all formulas</p> <p>POLAR COORDINATES (PC)</p>	<ul style="list-style-type: none"> - Apply knowledge of triangles to solve applied problems in surveying and navigation and bearing. - Determine areas of irregular triangles based on abilities to draw and apply previous knowledge. - Use systems of equations involving Law of Cosines to solve for angles of a quadrilateral inscribed in a circle. - Solve simple trig equations algebraically within a specified domain. - Relate inclination of a line with the slope of that line. - Write an equation of a line utilizing the concept of inclination. - Establish the relationships among the trig functions including: reciprocal, even/odd, Pythagorean, and co-function. - Simplify trigonometric expressions incorporating knowledge of algebra along with relationships among the functions. - Simplify trig identities. - Solve complex trig equations utilizing concepts of factoring, quadratic formula square rooting. - Give answers to trig equations in exact form where possible w/o calculators, otherwise return answers in either degrees or radians. - Derive and apply formulas for $\cos ()$ and $\sin ()$. - Use above formulas to determine exact values of expressions, including those involving inverse trigonometric functions. - Derive and apply formulas for: $\tan ()$. 	<p>9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>		<p>English, providing materials and/or resources to support students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed.</p> <p><u>Students at risk of school failure:</u> Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling.</p> <p><u>Gifted and Talented Students:</u> Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>
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	<p>PC-1 Polar Coordinates (PWL 9.6, 9.7, 6.5 and AM) (3 days) - Converting polar coordinates and equations to Cartesian and vice-versa. PC-2 Graphing Polar (PWL 9.7 and AM 11-1) (3 days) - Graphing points and equations using polar coordinates. PC-3 Powers of Complex Numbers (AM 11-3) (3 days) - DeMoivre’s Theorem PC-4 Roots of Complex Numbers (AM 11-4) (3 days)</p> <p>Content-specific modifications and accommodations - technology and multiple representations will be utilized to support conceptual understanding - differentiated problem sets can be used to support and challenge students</p> <p>Interdisciplinary/additional connections - various graphs may be explored, including those with contexts that draw on the experiences of diverse people and contexts that relate to climate change - applications to circular motion, navigation, and sinusoidal phenomena</p>	<ul style="list-style-type: none"> - Connect the concept of inclination of a line with addition formula for the tangent function in order to determine the angle between two lines. - Derive and apply double and half angle formulas for sine, cosine, and tangent. - Use graphing calculators to sketch the graphs of trigonometric functions involving double or half angles and determine the range and period of the function. - Prove identities as an aid in manipulating trigonometric functions for future applications in calculus. - Solve more complex trigonometric equations analytically and graphically within a given domain. - Identify different names for a point on the polar plane. - Graph polar equations. - Convert easily among: rectangular coordinates, rectangular form, polar coordinates, polar form of complex numbers. - Geometrically represent complex numbers. - Multiply and divide complex numbers in their polar form. - Apply DeMoivre’s Theorem to find powers of complex numbers in polar form. - Use the inverse of DeMoivre’s Theorem to determine the roots of a complex number in polar form. 			
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<p>Unit 2 – Vectors, Conics, Sequences & Series</p> <p>Time: 8-10 weeks (<i>see column 2 for a more detailed breakdown</i>)</p>	<p>Key learning items/concepts:</p> <ul style="list-style-type: none"> - Adding and subtracting vectors (PWL 6.3 and AM 12.1) (2 days) - Decomposing & resolving vectors (PWL 6.3) (2 days) - Application problems with vectors. (PWL 6.3, 6.4 and AM 12.1 – navigation) (2 days) - The dot product of two vectors. (PWL 6.4 and AM 12-4) (2 days) - Angle between vectors. (PWL 6.4) (2 days) - CS-1 Parabolas (PWL 9-1 and AM 6-5) – graphs, writing equations, applications (focus) (2 days) - CS-2 Circles (PWL 9-1 and AM 6-2) – graphs, writing equations, applications (equidistance) (2 days) - CS-3 Ellipses (PWL 9-2 and AM 6-3) – graphs, writing equations, applications (sound/light 	<ul style="list-style-type: none"> - 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. v, v, $\ v\$, v). - Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. - Solve problems involving velocity and other quantities that can be represented by vectors. - Add and Subtract Vectors. <ol style="list-style-type: none"> a) Add vectors end-to-end, component wise and by the parallelogram rule. Understand 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 vector subtraction $v - w$ as $v + (-w)$, where $-w$ as the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. - Multiply a vector by a scalar. <ol style="list-style-type: none"> a) Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component wise. - Prove theorems from geometry by using coordinates. 	<p>NJSLs Content Standards</p> <p>N-VM 1-5 G-GPE 1-4 F-IF 3, 8 G-MD 1 A-REI 7, 11 F-BF 1-2 F-LE 2 A-SSE 4</p> <p>NJSLs SMP</p> <p>MP1. Make sense of problems and persevere in solving them</p> <p>MP2. Construct viable arguments and critique the reasoning of others</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Form A, B, or C benchmark (B) - alternative assessments (A) - Take home exams and investigations (F) - Administration of previous AP 	<p>Selection of primary sources <i>Suggestion(s)</i>: Texts: Precalculus with Limits, Larson, Hostetler, Edwards; Houghton Mifflin Company, 2008 (on grade level); Advanced Mathematics, Brown; Houghton Mifflin Company, 1994 (on grade level); Calculus with Analytic Geometry, Larson, Hostetler; D. C. Heath and Company, 1990 (advanced); Deltamath (remediation, on grade level, and advanced)</p> <p>Additional Resources:</p> <p><i>o The Basic Practice of Statistics, Moore; W. H. Freeman & Co</i></p> <p><i>o Precalculus with Trigonometry, Foerster; Key Curriculum Press</i></p> <p><i>o Exploring Precalculus with The Geometer's Sketchpad, version 4, Scher, Kunkel, Lyublinskaya, and Steketeo</i></p> <p><i>o Exploring Calculus with The Geometer's Sketchpad, version</i></p>

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	<p>integration, architecture) (2 days) - CS-4 Hyperbolas (PWL 9-3 and AM 6-4) – graphs and writing equations, applications (echolocation) (2 days) - CS-5 Systems of Conics and Classifying Conics in standard form (2 days) - S&S-1 Sequences - Neither, Geometric and Arithmetic Sequences, Recursive and Explicit Definitions, (PWL 8.1-8.3 and AM 13.1 – 13.2) (2 days) - S&S-2 Finite Geometric and Arithmetic Series (AM 13.3 and PWL 8.2 – 8.3) (2 days) - S&S-3 Limits of Infinite Sequences (AM 13-4 and PWL 11-4) (2 days) - S&S-4 Infinite Geometric Series (AM 13-5 and PWL 8-3) (2 days) - S&S-5 Sigma Notation (AM 13-6 and PWL 8.1 – 8.3) (2 days) - S&S-6 Sums of powers of integers and proof by mathematical induction (AM13-6,7, PWL 8-4) (2 days)</p>	<ul style="list-style-type: none"> - Determine equations of circles from verbal descriptions and general form equations using completing the square. Identify center, radius, domain and range. - Apply circles as solutions to equidistance problems - Determine point(s) of intersection (algebraically) of a circle and a line, or two circles. - Use the concepts of translation and the definition of a parabola to sketch the graph - Determine equations of parabolas from verbal descriptions (utilizing distance to vertex, location of directrix, etc) and by using completing the square - Apply parabolas as solutions to focus problems - Utilize the concepts of translation and the definition of an ellipse to sketch the graph. - Determine equations of ellipses from verbal descriptions (utilizing major axis, minor axis, etc) and by using completing the square - Apply ellipses as solutions to architecture and sound/light integration problems - Utilize the concepts of translation and the definition of a hyperbola to sketch the graph. - Determine equations of hyperbolas and their asymptotes from verbal descriptions (utilizing distance between foci, distance between vertices, etc) and by using completing the square - Apply hyperbolas as solutions to echolocation problems 	<p>MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLS for ELA Companion Standards RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLS-CLKS - 21st Century Life and Careers</p>	<p>exam sections and questions based on relevant topics (F) - Conic discovery activities (F)</p>	<p><i>4, Clements, Rantozzi and Steketee</i> <i>o Exploring Conics with The Geometers' Sketchpad, Scher and Daniel</i> <i>o Conquering the New SAT Math, Postman and Postman</i> <i>o Grapher</i> <i>o Geometer's Sketchpad</i> <i>o Calculus-in-Motion</i> <i>o TI-83/TI-84 graphing calculator</i> Calculators: The TI-83, TI-83+, or TI-84 graphing calculators</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students' IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support</p>
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	<p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - technology and multiple representations will be utilized to support conceptual understanding - differentiated problem sets can be used to support and challenge students <p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - problems may include applications to science or engineering - applications to navigation, sound and light waves, and echolocation 	<ul style="list-style-type: none"> - Solve systems of second-degree equations algebraically and graphically, singularly and in combination. - Incorporate the concept of eccentricity to give a singular definition for all the conic sections. - Identify an arithmetic or geometric sequence and determine an explicit/recursive formula for nth term—derive the explicit formulas. - Determine an explicit/recursive formula for the nth term of sequences which are neither arithmetic nor geometric. - Apply formulas to solve problems—recursive definitions for population models, annuity problems, Fibonacci number problems, and Newton’s Law of Cooling. - Derive the sum of the first n terms of arithmetic and geometric series. - Determine the limit of an infinite sequence or determine that no limit exists. - Establish criteria necessary to be able to determine the sum of the infinite geometric series. - Use infinite series to express repeating decimals as a rational number. - Determine the interval of convergence for an infinite geometric series. - Apply sum formulas to verbal problems, including finance problems and converting a repeating decimal to a fraction - Represent series using sigma notation. - Establish properties of summations. - Express a given series using sigma notation and evaluate using established properties and formulas. 	<p>9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>		<p>students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed.</p> <p><u>Students at risk of school failure:</u> Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling.</p> <p><u>Gifted and Talented Students:</u> Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>
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		- Use mathematical induction to prove that a statement is true			
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<p>Unit 3 – Functions</p> <p>Time: 9-11 weeks (<i>see column 2 for a more detailed breakdown</i>)</p>	<p>Key learning items/concepts:</p> <p>LEF-1 Equations from geometry, linear equations and inequalities (AM 1.1-1.4., 3.1, PWL 1-1) (2 days)</p> <p>LEF-2 Function operations, composition, including rule, domain, range. (2 days)</p> <ul style="list-style-type: none"> - Algebraically, graphically, verbally (AM 4.2 and PWL 1-2, 3, 5) <p>LEF-3 Function Inverses: Domain restrictions to make invertible, rule, domain and range (PWL 1-6 and AM 4-5) (2 days)</p> <p>LEF-4 Periodic Functions: amplitude, period, values “off the graph” (AM 4-4) (2 days)</p> <p>LEF-5 Step functions, Function transformations: rigid, nonrigid, combinations of both, transformations of periodic functions (AM 4-4, 4-6, 4-7, Pre 1.4) (2 days)</p> <p>LEF-6 Function writing and optimization using the graphing calculator (AM 4-7) (3 days)</p> <p>NLF - 1 Quadratic and Polynomial graphs and functions, plus</p>	<ul style="list-style-type: none"> - Write line equations and expressions from verbal and geometric descriptions - Solve inequalities with absolute value functions - Perform function operations (including composition) algebraically and graphically, and determining domain and range - Invert functions algebraically and graphically, including situations that require domain restrictions - Transform function graphs using rigid and non-rigid transformations and combinations of both - Learn to evaluate and graph periodic and step functions - Write functions to describe verbal situations and find optimal values - Sketch and find equations for quadratic and polynomial functions - Solve quadratic and polynomial inequalities - Describe function characteristics, including <ul style="list-style-type: none"> - One-to-one - Odd/even - Increasing/decreasing - Boundedness - Maxima/minima - Continuity 	<p>NJSLS Content Standards</p> <p>G-GPE 6 A-REI 11 F-IF 7-9 F-BF 1, 3-5 G-GMD 3 A-SSE 3 A-APR 2, 6 F-LE 1, 4, 5</p> <p>NJSLS SMP</p> <p>MP1. Make sense of problems and persevere in solving them</p> <p>MP2. Construct viable arguments and critique the reasoning of others</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Form A, B, or C benchmark (B) - alternative assessments (A) - Take home exams and investigations (F) - Administration of previous AP 	<p>Selection of primary sources <i>Suggestion(s)</i>:</p> <p>Texts: Precalculus with Limits, Larson, Hostetler, Edwards; Houghton Mifflin Company, 2008 (on grade level); Advanced Mathematics, Brown; Houghton Mifflin Company, 1994 (on grade level); Calculus with Analytic Geometry, Larson, Hostetler; D. C. Heath and Company, 1990 (advanced); Deltamath (remediation, on grade level, and advanced)</p> <p>Additional Resources:</p> <ul style="list-style-type: none"> <i>o The Basic Practice of Statistics, Moore; W. H. Freeman & Co</i> <i>o Precalculus with Trigonometry, Foerster; Key Curriculum Press</i> <i>o Exploring Precalculus with The Geometer’s Sketchpad, version 4, Scher, Kunkel, Lyublinskaya, and Steketee</i> <i>o Exploring Calculus with The Geometer’s Sketchpad, version</i>

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	<p>inequalities (PWL 2.1, 2.2, AM 1-7, 1-8, 2-3, 3-2) (2 days) NLF - 2 Polynomial function models (AM 2-4) (2 days) NLF - 3 Synthetic substitution, root theorems (PWL 2.3, AM 2-7) (2 days) NLF - 4 Rational function graphs and inequalities (PWL 2.6 AM 3-3) (2 days) NLF - 5 Parametric equations (PWL 9.5) (3 days) EL - 1 Simplifying exponential expressions (AM 5-1,2) (2 days) EL - 2 Expanding and condensing logarithmic expressions. (PWL 3.3, AM 5-6) (2 days) EL - 3 Writing and graphing logarithmic and exponential functions (PWL 3.1-3.2 and AM 5-1,2) (2 days) EL - 4 Solving logarithmic equations. (PWL 3.4) (2 days) EL - 5 Applications of logarithms (PWL 3.2, 3.3, 3.4, AM 5-5) (Financial applications, growth and decay applications, half-life applications, decibels) (3 days)</p> <p>Content-specific modifications and accommodations - use multiple representations to support conceptual understanding - use technology to enhance student engagement</p>	<ul style="list-style-type: none"> - Write quadratic and polynomial models from verbal descriptions and find optimal values - Use synthetic substitution to evaluate functions and for division - Employ theorems of polynomial roots - Graph rational functions and solve rational inequalities - Evaluate, graph, and model with parametric equations - Simplify complicated exponential expressions - Expand and condense logarithmic expressions - Write and graph logarithmic and exponential functions, including using their inverse relationship - Solve logarithmic and exponential equations - Apply exponential and logarithmic models, including finance, growth/decay, half-life, decibels 	<p>MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLS for ELA Companion Standards RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLS-CLKS - 21st Century Life and Careers</p>	<p>exam sections and questions based on relevant topics (F) - Function modeling task (F)</p>	<p><i>4, Clements, Rantozzi and Steketee</i> <i>o Exploring Conics with The Geometers' Sketchpad, Scher and Daniel</i> <i>o Conquering the New SAT Math, Postman and Postman</i> <i>o Grapher</i> <i>o Geometer's Sketchpad</i> <i>o Calculus-in-Motion</i> <i>o TI-83/TI-84 graphing calculator</i> Calculators: The TI-83, TI-83+, or TI-84 graphing calculators</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students' IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support</p>
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	<p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - explore exponential and logarithmic applications in the Richter scale, ph scale, compounded interest and climate change - explore population growth for different groups around the world and in the United States 		<p>9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>	<p>students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed.</p> <p><u>Students at risk of school failure:</u> Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling.</p> <p><u>Gifted and Talented Students:</u> Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>
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<p>Unit 4 – Limits and Derivatives</p> <p>Time: 4 weeks (see column 2 for a more detailed breakdown)</p>	<p>Key learning items/concepts:</p> <p>LD - 1 Evaluating limits (PWL 11.1-11.3) (1 week) LD - 2 Using limits to find the derivatives of functions (PWL 11.4) (1 week) LD - 3 Derivatives of polynomials, sine and cosine, including tangent line problems (Calculus 2.1-2.2) (1 week) LD - 4 Product, Quotient, and Chain Rules (Calculus 2.3-2.4) (1 week)</p> <p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - this unit will spiral in concepts and skills that students learned in previous courses - differentiated problem sets can be used to support and challenge students <p>Interdisciplinary/additional connections</p>	<ul style="list-style-type: none"> - Given the graph of a function, or combinations of functions, determine: whether or not a functional value exists for a specific element of the domain, whether or not a limit exists for a specific element of the domain. - Connect the intuitive concept of a continuous function with the existence of a limit. - Use properties of limits and apply to functions with removable and non-removable discontinuities - Determine analytically limits of polynomial functions, rational function with limits going to infinity, rational functions with a common denominator, vertical asymptotes showing limits going to infinity - Determine analytically limits of polynomial functions using methods of simplification, rationalizing denominators/numerators. - Derive special trigonometric function limits 	<p>NJSLS Content Standards</p> <p>This unit builds on many of the concepts and skills learned in the New Jersey Student Learning Standards</p> <p>NJSLS SMP</p> <p>MP1. Make sense of problems and persevere in solving them MP2. Construct viable arguments and critique the reasoning of others MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - homework (F) - discussions (F) - journals (F) - Form A, B, or C benchmark (B) - alternative assessments (A) - Take home exams and investigations (F) 	<p>Selection of primary sources <i>Suggestion(s):</i> Texts: Precalculus with Limits, Larson, Hostetler, Edwards; Houghton Mifflin Company, 2008 (on grade level); Advanced Mathematics, Brown; Houghton Mifflin Company, 1994 (on grade level); Calculus with Analytic Geometry, Larson, Hostetler; D. C. Heath and Company, 1990 (advanced); Deltamath (remediation, on grade level, and advanced)</p> <p>Additional Resources:</p> <ul style="list-style-type: none"> <i>o The Basic Practice of Statistics, Moore; W. H. Freeman & Co</i> <i>o Precalculus with Trigonometry, Foerster; Key Curriculum Press</i> <i>o Exploring Precalculus with The Geometer's Sketchpad, version 4, Scher, Kunkel, Lyublinskaya, and Steketee</i> <i>o Exploring Calculus with The Geometer's Sketchpad, version 4, Clements, Rantozzi and Steketee</i> <i>o Exploring Conics with The Geometers' Sketchpad, Scher and Daniel</i>

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	<ul style="list-style-type: none"> - various graphs may be explored, including those with contexts that draw on the experiences of diverse people and contexts that relate to climate change - problems may include applications in science or engineering 	<ul style="list-style-type: none"> - Find one-sided limits and continuity on a closed interval. - Use the limit definition of a derivative to compute the slope and a formula for the slope of a given function - Apply formulas for taking derivatives of polynomial functions - Apply the product, quotient, and chain rules for derivatives - Use derivatives to find the equation of a tangent line 	<p>NJSLS for ELA Companion Standards RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLS-CLKS - 21st Century Life and Careers 9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>	<ul style="list-style-type: none"> - Administration of previous AP exam sections and questions based on relevant topics (F) 	<ul style="list-style-type: none"> <i>o Conquering the New SAT Math, Postman and Postman</i> <i>o Grapher</i> <i>o Geometer’s Sketchpad</i> <i>o Calculus-in-Motion</i> <i>o TI-83/TI-84 graphing calculator</i> <p>Calculators: The TI-83, TI-83+, or TI-84 graphing calculators</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students’ IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning.</p> <p>Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed.</p> <p>Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent</p>
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					<p>consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling.</p> <p>Gifted and Talented Students: Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>
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<p>Unit 5 – Statistics</p> <p>Time: 2-4 weeks (<i>see column 2 for a more detailed breakdown</i>)</p>	<p>Key learning items/concepts:</p> <ol style="list-style-type: none"> 1. Surveys, experiments, observational studies; compare two treatments; margin of error (1 week) 2. Estimate population percentages and areas under the normal curve (1 week) 3. Estimate population mean or proportion (1 week) <p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - use multiple representations and technology to support conceptual understanding - allow calculator use to focus attention on conceptual understanding <p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - draw on contexts with applications from other fields - draw on contexts with climate change applications 	<p><i>Understand and evaluate random processes underlying statistical experiments.</i></p> <p><i>Make inferences and justify conclusions from sample surveys, experiments, and observational studies.</i></p> <p><i>Summarize, represent, and interpret data on a single count or measurement variable.</i></p>	<p>NJSLs Content Standards</p> <p>S-IC 1-6 S-ID 4</p> <p>NJSLs SMP</p> <p>MP1. Make sense of problems and persevere in solving them MP2. Construct viable arguments and critique the reasoning of others MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLs for ELA Companion Standards</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency.</p> <p>Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Form A, B, or C benchmark (B) - alternative assessments (A) - Take home exams and 	<p>Selection of primary sources</p> <p><i>Suggestion(s):</i></p> <p>Texts: <i>Precalculus with Limits</i>, Larson, Hostetler, Edwards; Houghton Mifflin Company, 2008 (on grade level); <i>Advanced Mathematics</i>, Brown; Houghton Mifflin Company, 1994 (on grade level); <i>Calculus with Analytic Geometry</i>, Larson, Hostetler; D. C. Heath and Company, 1990 (advanced); <i>Deltamath</i> (remediation, on grade level, and advanced)</p> <p>Additional Resources:</p> <ul style="list-style-type: none"> <i>o The Basic Practice of Statistics</i>, Moore; W. H. Freeman & Co <i>o Precalculus with Trigonometry</i>, Foerster; Key Curriculum Press <i>o Exploring Precalculus with The Geometer’s Sketchpad, version 4</i>, Scher, Kunkel, Lyublinskaya, and Steketee <i>o Exploring Calculus with The Geometer’s Sketchpad, version 4</i>, Clements, Rantozzi and Steketee <i>o Exploring Conics with The Geometers’ Sketchpad</i>, Scher and Daniel <i>o Conquering the New SAT Math</i>, Postman and Postman <i>o Grapher</i> <i>o Geometer’s Sketchpad</i>

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	<p>- draw on contexts from diverse populations</p>		<p>RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLS-CLKS - 21st Century Life and Careers 9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3 9.4.12.TL.2 9.4.12.IML.4 9.4.12.IML.9 9.4.12.IML.10</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>	<p>investigations (F) - Administration of previous AP exam sections and questions based on relevant topics (F)</p>	<p><i>o Calculus-in-Motion</i> <i>o TI-83/TI-84 graphing calculator</i> Calculators: The TI-83, TI-83+, or TI-84 graphing calculators</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students’ IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed. Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling. Gifted and Talented Students: Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>
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