

Greenwich Public Schools Mathematics Curriculum Objectives

Pre-Calculus

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NUMERICAL AND PROPORTIONAL REASONING

Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technology.

Enduring Understandings:

- The concept of limits can be applied to sequences and to the asymptotic behavior of functions.
- The limit of a function is the value approached by $f(x)$ as x approaches a given value or infinity.
- Basic differentiation rules can be used to find the derivative of a function.

Essential Question:

- How can the concept of limits be applied in mathematics?
- What is the derivative of a function?

Cluster: Limits and an Introduction to Calculus

- PC.1.** Apply the concept of a limit: define a limit of a function and explain how a limit can fail to exist, evaluate a limit (by direct substitution, simplification, and one-sided limits).
- PC.2.** Apply the concept of a derivative: determine the tangent line to a graph, evaluate a derivative by the limit process and evaluate derivatives by formula.

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GEOMETRY AND MEASUREMENT

Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools, and technology.

Enduring Understandings:

- Trigonometry can be used to determine indirect measurements of lengths and angles to solve a variety of problems.

Essential Question:

- What is the relationship between right-triangle trigonometry and circular trigonometry and how can each be applied to solve real-world problems?

Cluster: Trigonometric Functions

- PC.3.** Use trigonometry to find unknown sides or angles of a right triangle including problems involving the angle of elevation or the angle of depression.
- PC.4.** Determine the arc length and area of a sector of a circle.
- PC.5.** Solve problems involving apparent size.
- PC.6.** Discuss the connection between trigonometry as defined within a triangle versus within a circle.
- PC.7.** Find the measure of an angle in degrees or radians.
- PC.8.** Find coterminal angles.
- PC.9.** Determine the domain and range of sine and cosine.
- PC.10.** Find the trigonometric functions of familiar angles (quadrantal, 30° , 45° , 60°) without a calculator.
- PC.11.** Use reference angles to find trigonometric functions for any angle.
- PC.12.** Apply basic trigonometric functions to solve problems involving measurement and latitude.
- PC.13.** Graph sine and cosine functions, identify amplitude and period, and perform translations.
- PC.14.** Model real life data using sine and cosine functions.
- PC.15.** Evaluate inverse trigonometric functions.

Cluster: Additional Topics in Trigonometry

- PC.16.** Apply the Law of Sines to determine the area of triangles, unknown parts of triangles (sides and/or angles) and identify and resolve the ambiguous case.
- PC.17.** Apply the Law of Cosines to find unknown parts (sides and/or angles) of a triangle.
- PC.18.** Apply Heron's (Heron's) formula to find the area of the triangle.
- PC.19.** Apply trigonometry to solve navigation and surveying problems with an emphasis on bearings.

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ALGEBRAIC REASONING: PATTERNS AND FUNCTIONS

Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technology.

Enduring Understandings:

- Mathematical functions can be used to solve real world applications.
- Various graphical and algebraic methods can be used to analyze and solve systems of linear and quadratic equations.
- Conic sections can be identified and graphed from their equations.
- Exponential and logarithmic functions are inverse functions.

Essential Questions:

- How can graphs and equations of functions and their inverses help us to interpret real world problems?
- What are the characteristics of the conic sections and how do they apply to real-world problems?
- How can analytic and graphical methods be used to support each other in the solution of a problem?

Cluster: Simple Functions

- PC.20.** Apply the concept of a function: differentiate functions from relations using the Vertical Line Test, identify domain and range, and identify increasing/decreasing intervals and relative extrema of a graph.
- PC.21.** Evaluate a function using function notation, given a value of the independent variable.
- PC.22.** Graph special functions: piecewise (compound) functions and the greatest integer function.
- PC.23.** Recognize rigid and nonrigid transformations of functions algebraically and graphically.
- PC.24.** Perform compositions of functions and identify the domain of a composite function.
- PC.25.** Apply the concept of the inverse of a function: determine the inverse, recognize and interpret $f^{-1}(x)$ notation, graph inverse functions using the reflective property in the line $y = x$, verify inverse functions graphically and algebraically using composition of functions.
- PC.26.** Identify one-to-one functions by applying the Horizontal Line Test.

Cluster: Polynomial and Rational Functions

- PC.27.** Apply the concept of a quadratic function: graph quadratic functions in both standard and vertex form, write the equation of a quadratic in standard form, apply methods of solving quadratic equations to solve optimization and other real world applications.

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- PC.28.** Apply the concept of a polynomial function: employ the Leading Coefficient Test to graph basic polynomials, determine the zeros of polynomials by factoring, synthetic division, conjugate pairs, and/or graphing calculator, recognize and interpret the zeros of a polynomial function to derive the standard form of the polynomial.
- PC.29.** Analyze the concept of a zero using the Remainder Theorem, Factor Theorem, Rational Root Theorem and the Fundamental Theorem of Algebra.
- PC.30.** Perform basic operations with complex numbers including the use of conjugates.
- PC.31.** Understand the definition of continuity of a function and identify all discontinuities.
- PC.32.** Apply the concept of a rational function: determine and graph the asymptotes (vertical and/or horizontal), points of removable discontinuity, and intercepts.
- PC.33.** Determine all asymptotes (vertical, horizontal, and/or slant) of a rational function.

Cluster: Exponential and Logarithmic Functions

- PC.34.** Graph exponential and logarithmic functions and apply and interpret transformations to the graphs.
- PC.35.** Simplify and expand expressions applying the properties of logarithms.
- PC.36.** Evaluate logs in base 10 and base e and apply change of base formula.
- PC.37.** Convert from exponential to logarithmic form and vice versa.
- PC.38.** Model exponential growth and decay.
- PC.39.** Solve exponential and logarithmic equations.

Cluster: Systems of Equations and Inequalities

- PC.40.** Solve systems of linear and nonlinear equations graphically and algebraically (linear combination and substitution).

Cluster: Analytic Trigonometry

- PC.41.** Simplify trigonometric expressions, prove trigonometric identities, and solve trigonometric equations utilizing the fundamental identities, sum and difference formulas, and double and half-angle formulas.

Cluster: Conic Sections and Polar Coordinates

- PC.42.** Apply knowledge of conics to determine their equations, identify their specific characteristics and clarify them by their equation and apply them in applications.
- PC.43.** Solve a system of quadratic equations algebraically and graphically.
- PC.44.** Apply the concept of polar coordinates: graph points in polar form, convert coordinates between polar and rectangular form, convert equations into polar and rectangular form and graph polar equations by hand point plotting and by calculator.