Pequea Valley School District
Math

Course: Honors PreCalc **Grade**: 9, 10, 11, 12

Unit 1: Preparing for PreCalculus

Unit Essential Question: What algebra skills are essential to preparing for PreCalc?

CONCEPT	CONCEPT	CONCEPT	CONCEPT	CONCEPT
Sets	**Operations with Complex Numbers**	**Quadratic Functions and Equations**	**Nth Roots and Real Exponents**	**Systems of Linear Equations and Inequalities**
VOCABULARY	**VOCABULARY**	**VOCABULARY**	**VOCABULARY**	**VOCABULARY**
Set, Subset, Element, Universal set, Complement, Union, Intersection, Empty Set	Imaginary unit, Complex number, Standard form, Real part, Imaginary part, Pure imaginary number, Complex conjugates	Parabola, Axis of symmetry, Vertex, Quadratic equation, Quadratic Formula, Vertex form, Standard form, Intercept form	Nth roots, radical exponents, Product Property of Radicals, Quotient Property of Radicals	Systems of equations, Systems of inequalities, Substitution, Elimination,
KNOW	**KNOW**	**KNOW**	**KNOW**	**KNOW**
• Set notation • Unions and intersections • Complements	• Imaginary unit = i • $i^2=-1$ • a + bi • Complex conjugates • Simplifying complex numbers	• Graphs of quadratics • 3 Forms of quadratics • Zeros of quadratics	• Radical to rational exponent form • Product and Quotient Properties of Radicals	• Substitution • Elimination • Graphical solutions to systems

UNDERSTAND	UNDERSTAND	UNDERSTAND	UNDERSTAND	UNDERSTAND
• How to find unions, intersections and complements of sets	• How to simplify complex numbers • How to use complex conjugates to simplify	• How to graph parabolas in 3 forms • The symmetric properties of quadratics • How to solve quadratics	• How to simplify radicals • How to simplify expressions in rational exponent form • When an expression is fully simplified	• How to solve a system of equations • How to solve a system of inequalities
LEARNING OUTCOME	**LEARNING OUTCOME**	**LEARNING OUTCOME**	**LEARNING OUTCOME**	**LEARNING OUTCOME**
• Learners will be able to identify unions, intersections and complements of sets.	• Learners will be able to simplify complex numbers.	• Learners will be able to solve real world problems involving analyzing graphs of quadratics functions. • Learners will be able to solve real life applications of quadratic functions.	• Learners will be able to simplify expressions involving radicals or rational exponents	• Learners will be able to identify and solve situations in which a system of equations/inequalities is useful.

Pa Core Standards:

CC.2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.

CC.2.2.HS.D.9 Use reasoning to solve equations and justify the solution method.

CC.2.2.HS.D.10 Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

Assessments: Unit Assessment

Pacing: 15 days (including assessment)

Resources: McGraw-Hill PreCalculus

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Math

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Unit 2: Functions from a Calculus Perspective Part 1

Unit Essential Question: How can we use graphs of functions to analyze and solve real world situations?

CONCEPT	CONCEPT	CONCEPT	CONCEPT
Functions	**Analyzing Graphs of Functions and Relations**	**Continuity, End Behavior, and Limits**	**Extrema and Average Rates of Change**
VOCABULARY	**VOCABULARY**	**VOCABULARY**	**VOCABULARY**
Set -builder notation, Interval notation, Function, Independent variable, Dependent variable, Implied domain, Relevant domain, Piece-wise function	Zeros, Roots, Line symmetry, Point symmetry, Even function, Odd function	Continuous function, Limit, Discontinuous function, Jump discontinuity, Removable discontinuity, Nonremovable discontinuity, End behavior	Increasing, Decreasing, Constant, Critical point, Extrema, Maximum, Minimum, Point of inflection, Average rate of change, Relative extrema, Absolute extrema
KNOW	**KNOW**	**KNOW**	**KNOW**
• Subsets of real numbers • Set-builder notation • Interval notation • Definition of function • Implied vs relevant domain	• Synonyms for zeros • Different forms of symmetry • Even and Odd functions	• Continuity • Types of discontinuity • End behavior and limits	• Various points on a graph • Average rate of change of nonlinear functions
UNDERSTAND	**UNDERSTAND**	**UNDERSTAND**	**UNDERSTAND**
• How to identify functions • How to define sets using set-builder and interval notation • How to define domain using	• How to identify even and odd functions • How to confirm algebraically	• The Continuity Test • How to use limits to represent end behavior • What causes different types of discontinuity	• How to analyze a graph based on critical points. • Average rate of change on nonlinear functions is an “average”

set-builder and interval notation • How to evaluate, graph and write piece-wise functions			
LEARNING OUTCOME	**LEARNING OUTCOME**	**LEARNING OUTCOME**	**LEARNING OUTCOME**
• Learners will be able to use set-builder and interval notation to describe sets and domain. • Learners will understand how to identify implied and relevant domain and range from functions and their graphs.	• Learners will be able to identify even and odd functions, and confirm it algebraically	• Learners will be able to identify different types of discontinuity and the reasons for it	• Learners will be able to analyze critical points on graphs of functions • Learners will be able to find average rate of change on nonlinear functions.

Pa Core Standards:

CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context.

CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.

CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.

CC.2.2.HS.C.4 Interpret the effects transformations have on functions and find the inverses of functions.

CC.2.2.HS.C.5 Construct and compare linear, quadratic, and exponential models to solve problems.

CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.

Assessments: Unit Assessment

Pacing: 12 days (including assessment)

Resources: McGraw-Hill PreCalculus

Pequea Valley School District
Math

Course: **Honors PreCalc** **Grade:** **9, 10, 11, 12**

Unit 2: Functions from a Calculus Perspective Part 2

Unit Essential Question: **How can we use graphs of functions to analyze and solve real world situations?**

CONCEPT
Parent Functions and Transformations
VOCABULARY
Parent function, Constant function, Zero function, Identity function, Quadratic function, Cubic function, Square root function, Reciprocal function, Absolute value function, Step function, Greatest integer, Translation, Transformation, Reflection, Dilation, Rigid transformation, Nonrigid transformation, Vertical stretch (expansion)/shrink (compression), Horizontal stretch/shrink, HSRV
KNOW
• Transformations of graphs • How to graph piece-wise functions

CONCEPT
Function Operations and Composition of Functions
VOCABULARY
Composition function
KNOW
• Operations with functions • Operations with restricted domains • Decomposing functions

CONCEPT
Inverse Relations and Functions
VOCABULARY
Inverse relation, Inverse function, One-to-one, Horizontal Line Test
KNOW
• Inverse relations/functions and their characteristics • How to find inverse relations/functions • Horizontal Line Test • One-to-one

UNDERSTAND	UNDERSTAND	UNDERSTAND
• The order in which transformations occur • Transformations by looking at the function and also the graph of the function	• Restricted domain and when that occurs • Composition functions	• How functions and their inverses are related • Domain restrictions as it pertains to functions and their inverses
LEARNING OUTCOME	**LEARNING OUTCOME**	**LEARNING OUTCOME**
• Learners will be able to describe transformations of graphs of functions.	• Learners will be able to compose functions and state domain restrictions • Learners will be able to decompose functions • Learners will be able to compose functions for real-world situations and understand their relevant domain.	• Learners will be able to find inverse functions and state their domains.

Pa Core Standards:

CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context.

CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.

CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.

CC.2.2.HS.C.4 Interpret the effects transformations have on functions and find the inverses of functions.

CC.2.2.HS.C.5 Construct and compare linear, quadratic, and exponential models to solve problems.

CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.

Assessments: Unit Assessment

Pacing: 13 days (including assessment)

Resources: McGraw-Hill PreCalculus

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Unit 3: Power, Polynomial and Rational Functions

Unit Essential Question: How is mathematics used to model real-world situations?

CONCEPT	CONCEPT	CONCEPT	CONCEPT
Power and Radical Functions	**Polynomial Functions**	**The Remainder and Factor Theorems and Zeros of Polynomial Functions**	**Rational Functions**
VOCABULARY	**VOCABULARY**	**VOCABULARY**	**VOCABULARY**
Power function, Monomial function, Radical function, Extraneous Solution	Polynomial function, Degree, Leading coefficient, Leading-term Test, quartic function, Turning point, Quadratic form, Repeated zero, Multiplicity	Synthetic division, Depressed polynomial, Synthetic substitution, Rational Zero Theorem, Upper bound, Lower bound, Fundamental Theorem of Algebra, Complex conjugate, Irreducible over the reals	Rational function, Asymptote, Vertical asymptote, Horizontal asymptote, Oblique asymptote, Holes
KNOW	**KNOW**	**KNOW**	**KNOW**
• Power regressions • Graphs of radical functions • Solving radical equations	• Graphs of polynomial functions • End behavior of polynomial functions • Zeros and turning points of polynomial functions	• Polynomial long division • Synthetic division • Remainder Theorem • Factor Theorem • Rational Zero Theorem • Fundamental Theorem of Algebra	• Different types of asymptotes • Solving rational equations • LCD of rational expressions

UNDERSTAND	UNDERSTAND	UNDERSTAND	UNDERSTAND
• How to analyze graphs of power and radical functions • How to solve radical equations	• Multiplicity of zeros and how to identify it • Graphs of polynomials	• When synthetic division can be used • The mathematical definition of Remainder and Factor Theorems • How to find all zeros of polynomial functions	• Algebraically what causes each type of asymptote • Process for solving rational equations
LEARNING OUTCOME	**LEARNING OUTCOME**	**LEARNING OUTCOME**	**LEARNING OUTCOME**
• Learners will be able to analyze graphs of radical functions that pertain to real world situations. • Learners will be able to solve radical equations.	• Learners will be able to graph and analyze polynomial functions pertaining to real world situations.	• Learners will be able to solve polynomial functions in the real world through use of the Remainder, Factor and Fundamental Theorem of Algebra Theorems.	• Learners will be able to identify asymptotes of rational functions algebraically and graphically. • Learners will be able to solve rational equations that model real life situations.

Pa Core Standards:

CC.2.2.HS.C.5 Construct and compare linear, quadratic and exponential models to solve problems.
CC.2.2.HS.D.9 Use reasoning to solve equations and justify the solution method.
CC.2.2.HS.D.7 Create and graph equations or inequalities to describe numbers or relationships.
CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.
CC.2.2.HS.C.6 Interpret functions in terms of the situation they model.
CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.
CC.2.1.HS.F.7 Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems.
CC.2.2.HS.D.5 Use polynomial identities to solve problems.
CC.2.2.HS.D.4 Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.
CC.2.2.HS.D.3 Extend the knowledge of arithmetic operations and apply to polynomials.

Assessments: Unit Assessment

Pacing: 23 days (including assessment)

Resources: McGraw-Hill PreCalculus

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Unit 4: Exponential and Logarithmic Functions

Unit Essential Question: **How are exponential and logarithmic functions used in the real world?**

CONCEPT	CONCEPT	CONCEPT	CONCEPT
Exponential Functions	**Logarithmic Functions**	**Exponential and Logarithmic Equations**	**Modeling with Nonlinear Regression**
VOCABULARY	**VOCABULARY**	**VOCABULARY**	**VOCABULARY**
Algebraic function, Transcendental function, Exponential function, Natural base, Continuous compound interest	Logarithmic function, Logarithm, Common logarithm, Natural logarithm		Logistic growth function, linearize
KNOW	**KNOW**	**KNOW**	**KNOW**
• Exponential growth and decay • Transformations of graphs of exponential functions • The Natural Number (Euler Number) • Compound interest • Exponential models for real life examples	• Logarithmic form vs exponential form • Properties of logarithms • Graphs of logarithms	• Procedures for solving logarithmic and exponential equations	• Regressions on the graphing calculator
UNDERSTAND	**UNDERSTAND**	**UNDERSTAND**	**UNDERSTAND**
• Exponential functions in real life situations	• Transformations of graphs of logarithms • How to apply the properties of logarithms	• Logarithmic and exponential functions are inverse functions • How to solve	• How to model data using regressions

LEARNING OUTCOME • Learners will be able to model real life situations with exponential functions.	• Evaluating logarithms **LEARNING OUTCOME** • Learners will be able to graph and evaluate logarithmic functions.	exponential and logarithmic equations **LEARNING OUTCOME** • Learners will be able to solve exponential and logarithmic functions as they pertain to situations in the real world.	**LEARNING OUTCOME** • Learners will be able to identify and analyze trends in data through use of regressions.

Pa Core Standards:

CC.2.2.HS.C.4 Interpret the effects transformations have on functions and find the inverses of functions.

CC.2.2.HS.D.8 Apply inverse operations to solve equations or formulas for a given variable.

CC.2.2.HS.D.9 Use reasoning to solve equations and justify the solution method.

CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.

CC.2.2.HS.C.6 Interpret functions in terms of the situation they model.

CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.

Assessments: Unit Assessment

Pacing: 25 days (including assessment)

Resources: McGraw-Hill PreCalculus

Pequea Valley School District
Math

Course: Honors PreCalc Grade: 9, 10, 11, 12

Unit 5: Trigonometric Functions Part 1

Unit Essential Question: How can we use trigonometry to solve real world situations?

CONCEPT
Right Triangle Trigonometry
VOCABULARY
Trigonometric ratios, Trigonometric functions, Sine, Cosine, Tangent, Secant, Cosecant, Cotangent, Reciprocal function, Inverse trigonometric function, Inverse Sine, Inverse Cosine, Inverse Tangent, Angle of Elevation, Angle of Depression, Solve a right triangle
KNOW
• SOH-CAH-TOA • Solving right triangles

CONCEPT
Degrees and Radians
VOCABULARY
Vertex, Initial side, Terminal side, Standard position, Radian, Coterminal angles, Linear speed, Angular speed, Sector
KNOW
• Radians vs degrees • Coterminal angles • Linear speed • Angular speed • Area of sectors • Arc length

CONCEPT
Trigonometric Functions on the Unit Circle
VOCABULARY
Quadrantal angle, Reference angle, Unit circle, Circular function, Periodic function, Period
KNOW
• The unit circle • Reference angles • Evaluating trig functions of angles

UNDERSTAND	UNDERSTAND	UNDERSTAND
• Angles of elevation and depression • Uses of SOH-CAH-TOA	• The difference between angular and linear speed • Converting from degrees to radians • Importance of coterminal angles	• The Unit circle • How to evaluate trig functions using reference angles
LEARNING OUTCOME	**LEARNING OUTCOME**	**LEARNING OUTCOME**
• Learners will be able to solve real life situations involving right triangle trigonometry	• Learners will be able to solve real life situations utilizing knowledge of degrees and radians, as well as linear and angular speed.	• Learners will be able to solve real world trig problems using the unit circle. • Learners will understand the unit circle and its uses.

Pa Core Standards:

CC.2.3.HS.A.7 Apply trigonometric ratios to solve problems involving right triangles.

Assessments: Unit Assessment

Pacing: 25 days (including assessment)

Resources: McGraw-Hill PreCalculus

LEARNING OUTCOME • Learners will be able to model real life situations with exponential functions.	• Evaluating logarithms **LEARNING OUTCOME** • Learners will be able to graph and evaluate logarithmic functions.	exponential and logarithmic equations **LEARNING OUTCOME** • Learners will be able to solve exponential and logarithmic functions as they pertain to situations in the real world.	**LEARNING OUTCOME** • Learners will be able to identify and analyze trends in data through use of regressions.

Pa Core Standards:

CC.2.2.HS.C.4 Interpret the effects transformations have on functions and find the inverses of functions.

CC.2.2.HS.D.8 Apply inverse operations to solve equations or formulas for a given variable.

CC.2.2.HS.D.9 Use reasoning to solve equations and justify the solution method.

CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.

CC.2.2.HS.C.6 Interpret functions in terms of the situation they model.

CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.

Assessments: Unit Assessment

Pacing: 25 days (including assessment)

Resources: McGraw-Hill PreCalculus

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Course: Honors PreCalc Grade: 9, 10, 11, 12

Unit 6: Trigonometric Identities

Unit Essential Question: What are trigonometric identities ?

CONCEPT
Trigonometric Identities
VOCABULARY
Identity, Trigonometric identity, Cofunction
KNOW
• Basic trig identities • Reciprocal identities • Pythagorean identities
UNDERSTAND
• How to simplify trig identities
LEARNING OUTCOME
• Learners will be able to simplify trig identities.

CONCEPT
Verifying Trig Identities
VOCABULARY
Verify an identity
KNOW
• What "verify" means in terms of trig identities
UNDERSTAND
• How to verify trig functions
LEARNING OUTCOME
• Learners will be able to verify trig functions.

Pa Core Standards:

There are no standards that apply to this unit

Assessments: Unit Assessment (Quiz)
Pacing: 14 days (including assessment)
Resources: McGraw-Hill PreCalculus