

Unit P: Prerequisites & Algebra Review

Overview: This preliminary unit reviews essential algebraic foundations, preparing students for the rigor of Precalculus. Topics include real numbers, complex numbers, solving equations and inequalities, and using multiple representations (graphical, numerical, algebraic) of functions and relations.

<p>Topic/Theme Duration</p>	<p>PREREQUISITES & ALGEBRA REVIEW SEPTEMBER – MID OCTOBER (4 WEEKS)</p>
<p>Focus Question/s</p>	<ul style="list-style-type: none"> • What algebra skills must we master to succeed in Precalculus? • How can graphs, tables, and formulas each help us understand a function or equation? • When solving a problem, how do we decide which representation is most efficient?
<p>Standards</p>	<p>F.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.</p> <p>A.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.</p> <p>A.CED.A.2 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>S.REI.D.11 - Explain why the x-coordinates of the points where the graphs of the equation $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$.</p> <p>F.IF.7 Graph functions and show key features of the graph by hand and using technology when appropriate.</p> <p>F-IF-7.a: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>A-CED-2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p>

Key Student Learning Objectives	Students will be able to: <ul style="list-style-type: none">• Reinforce fluency with algebraic manipulations, exponents, radicals, and complex numbers.• Strengthen solving of linear, quadratic, and absolute value equations/inequalities.• Prepare students to use and interpret multiple representations (graphs, tables, formulas).
Learning Targets	<ul style="list-style-type: none">• I can simplify expressions with exponents, radicals, and complex numbers.• I can solve linear, quadratic, and absolute value equations and inequalities.• I can interpret and convert between graphical, numerical (tables), and algebraic representations.• I can identify when different representations are most useful in solving a problem.

Unit 1: Functions and Graphs

Overview: This unit introduces the formal notion of a function and explores its properties. Students study basic parent functions, how to build new functions (transformations, operations, composition), how to find inverses, and how to model real-world data with functions.

Topic/Theme Duration	FUNCTIONS AND GRAPHS MID OCTOBER-NOVEMBER (4 WEEKS)
Focus Question/s	<ul style="list-style-type: none">• What makes a relation a function?• How do transformations change a base graph?• How does composition relate input-output chains?• When is an inverse function meaningful, and how can we find it?• How do parametric and explicit function forms connect?
Standards	<p>F.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.</p> <p>A.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.</p> <p>A.CED.A.2 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>S.REI.D.11 - Explain why the x-coordinates of the points where the graphs of the equation $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$.</p> <p>F.IF.7 Graph functions and show key features of the graph by hand and using technology when appropriate.</p> <p>F-IF-7.a: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>A-CED-2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p>
Key Student Learning Objectives	<p>Students will be able to:</p> <ul style="list-style-type: none">• Define, evaluate, and interpret functions in multiple forms (table, graph, formula, context).• Analyze the behavior of functions (domain, range, continuity, monotonicity, symmetry).

	<ul style="list-style-type: none">• Perform and interpret transformations (translations, reflections, dilations).• Combine and compose functions.• Find inverses, and work with parametric representations where applicable.• Model situations by selecting or constructing appropriate functions.
Learning Targets	<ul style="list-style-type: none">• I can define domain and range, intercepts, maxima/minima, and other features from graphs or formulas.• I can describe and graph transformations of basic parent functions.• I can add, subtract, multiply, divide, and compose functions, and find their domains.• I can determine if a function is invertible, find its inverse, and verify by composition.• I can convert to/from parametric representations and relate them to function graphs.• I can use function models to represent real-world contexts.

Unit 2: Polynomial, Power, and Rational Functions

Overview: This unit guides students through higher-degree polynomials, power functions, and rational functions. Emphasis is on zeros, multiplicity, division, asymptotic behavior, inequality solving, and modeling using polynomial and rational functions.

Topic/Theme Duration	POLYNOMIAL, POWER, AND RATIONAL FUNCTIONS AND THEIR CHARACTERISTICS DECEMBER – BEGINNING OF JANUARY (4-5 WEEKS)
Focus Question/s	<ul style="list-style-type: none">• How does multiplicity of zeros affect the graph near those zeros?• What strategies let us divide polynomials efficiently?• How do we detect and graph asymptotes and removable discontinuities?• Why are some solutions extraneous and how do we check them?• When should we use rational vs. polynomial models in real-life situations?
Standards	<p>A.SSE Interpret the structure of expressions.</p> <p>A.APR.1 Add, subtract, and multiply polynomials and recognize that the result of the operation is also a polynomial. This forms a system analogous to the integers.</p> <p>A.SSE.A.1.a: Interpret parts of an expression, such as terms, factors, and coefficients.</p> <p>F.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.</p> <p>A.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.</p> <p>A.CED.A.2 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>S.REI.D.11 - Explain why the x-coordinates of the points where the graphs of the equation $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$.</p> <p>A.SSE.A.1 - Interpret expressions that represent a quantity in terms of its context.</p> <p>F.IF.7 Graph functions and show key features of the graph by hand and using technology when appropriate.</p> <p>A.APR.B: Understand the relationship between zeros and factors of polynomials.</p> <p>F-IF-7.a: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for</p>

	<p>more complicated cases. Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>A-REI-11: Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations, include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.</p> <p>F.IF.7.c: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.</p> <p>A-REI-4.b: Solve quadratic equations by inspection, taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm b$ for real numbers a and b.</p> <p>F-IF-8.a: Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.</p>
<p>Key Student Learning Objectives</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> • Expand, factor, and manipulate polynomial expressions; apply division algorithms. • Use synthetic and long division, rational root theorem, factor theorem. • Determine complex zeros and apply the Fundamental Theorem of Algebra. • Analyze and graph rational functions, identifying vertical, horizontal, and slant asymptotes, and holes. • Solve polynomial and rational equations and inequalities, including checking extraneous roots. • Model real phenomena with polynomial or rational functions
<p>Learning Targets</p>	<ul style="list-style-type: none"> • I can factor polynomials, apply the factor theorem, and find zeros. • I can perform polynomial long division and synthetic division. • I can determine the end behavior based on degree and leading coefficient. • I can graph rational functions and identify asymptotes, holes, and behavior near extremes. • I can solve rational equations and inequalities, and interpret solutions in context.

Unit 3 : Exponential, Logistic, and Logarithmic Functions

Overview: This unit covers exponential growth and decay, logistic functions, logarithms, and their applications (finance, population, cooling). Students explore the inverse relationship between exponentials and logs, the laws of logarithms, and apply these to solve equations and model real-world phenomena.

Topic/Theme Duration	EXPONENTIAL, LOGISTIC AND LOGARITHMIC FUNCTIONS MID JANUARY – MID FEBRUARY (3-4 WEEKS)
Focus Question/s	<ul style="list-style-type: none">• How do exponential and logistic models differ in long-term behavior?• What does the inverse of an exponential tell us in real contexts?• How do properties of logarithms help us solve otherwise difficult equations?• Which real-world phenomena are best modeled by exponential or logistic equations?
Standards	<p>F.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.</p> <p>A.CED.A.2 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>F.IF.7 Graph functions and show key features of the graph by hand and using technology when appropriate.</p> <p>F-IF-7.a: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>F.IF.7.e: Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.</p>
Key Student Learning Objectives	<p>Students will be able to:</p> <ul style="list-style-type: none">• Define and graph exponential functions (growth, decay, logistic).• Interpret parameters (initial value, growth/decay rate, carrying capacity).• Define and graph logarithms, including domain, asymptote, and range.• Use log properties (product, quotient, power, change of base) for simplification.

	<ul style="list-style-type: none">• Solve exponential and logarithmic equations, including those arising from applications.• Model real-world contexts: compound interest, continuous growth, population dynamics, Newton's law of cooling.•
Learning Targets	<ul style="list-style-type: none">• I can distinguish linear vs exponential vs logistic behaviors.• I can write exponential models and interpret their parameters.• I can convert between exponential and logarithmic forms.• I can simplify expressions using log properties.• I can solve equations that involve exponentials or logarithms.• I can apply these models to real-life contexts such as finance or growth phenomena.

Unit 4: Analytic Geometry

Overview:

Topic/Theme Duration	ANALYTIC GEOMETRY FEBRUARY-MARCH (3 WEEKS)
Focus Question/s	<ul style="list-style-type: none">• How does the unit circle define trig functions for all angles?•
Standards	<ul style="list-style-type: none">•
Key Student Learning Objectives	Students will be able to: <ul style="list-style-type: none">• Understand and apply the coordinate plane as a tool to describe geometric figures algebraically.• Derive and graph equations of circles, parabolas, ellipses, and hyperbolas from geometric definitions.• Analyze and interpret the geometric meaning of parameters in conic section equations.• Classify conic sections based on their equations and determine their key features.• Use algebraic techniques to prove geometric properties and solve problems involving distance, slope, and area.• Apply analytic geometry to model real-world phenomena and interpret graphical representations.
Learning Targets	Circles <ul style="list-style-type: none">• I can define a circle and relate its geometric definition to its algebraic equation.• I can write the equation of a circle given its center and radius.• I can identify the center and radius of a circle from its equation and graph it accurately. Parabolas

- I can describe a parabola as the set of points equidistant from a focus and a directrix.
- I can derive the standard form of a parabola's equation from geometric conditions.
- I can identify and interpret the vertex, focus, axis of symmetry, and directrix from an equation.

Ellipses

- I can define an ellipse as the set of points whose sum of distances from two foci is constant.
- I can write the standard form of an ellipse and identify its major and minor axes.
- I can graph ellipses and describe how changes in parameters affect their shape and orientation.

Hyperbolas

- I can define a hyperbola as the set of points whose difference of distances from two foci is constant.
- I can derive the standard form of a hyperbola's equation from its geometric definition.
- I can identify vertices, foci, and asymptotes, and use them to graph hyperbolas.

Applications and Problem Solving

- I can classify conic sections given their general equations.
- I can apply transformations (translations and reflections) to conic graphs.
- I can use conic sections to model and solve real-world problems (e.g., planetary motion, satellite dishes).
- I can verify geometric theorems and relationships using coordinate methods.
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Unit 5: Trigonometric Functions

Overview: This unit develops students' understanding of trigonometry via the unit circle, right-triangle definitions, graphing trigonometric functions (sine, cosine, tangent, and reciprocals), and transformations. Applications to periodic behavior form a critical component.

Topic/Theme Duration	TRIGONOMETRIC FUNCTIONS MARCH- APRIL (4-5 WEEKS)
Focus Question/s	<ul style="list-style-type: none">• How does the unit circle define trig functions for all angles?• How do amplitude, period, and shift affect a trig graph?• What relationships exist among trig functions and their reciprocals?• How can trig models represent motion, waves, or cycles in nature?
Standards	<p>F.TF.A.1: Understand radian measure of an angle as arc length on a unit circle.</p> <p>F.TF.A.3: Use special triangles to determine values of sine, cosine, and tangent.</p> <p>F.TF.B.5: Graph trigonometric functions, identifying amplitude, period, phase shift, and midline.</p> <p>F.TF.C.8: Use trigonometric identities to simplify expressions and solve equations.</p>
Key Student Learning Objectives	<p>Students will be able to:</p> <ul style="list-style-type: none">• Convert between degree and radian measures; relate to arc length.• Define the six trigonometric functions using the unit circle.• Evaluate trig functions for special angles and use reference angles.• Graph basic trigonometric functions and perform transformations (amplitude, period, shift, reflection).• Understand inverse trigonometric functions and solve simple trig equations.• Use trigonometric functions to model periodic phenomena.

Learning Targets

- I can convert between radians and degrees and compute arc lengths.
- I can evaluate trigonometric functions using the unit circle.
- I can graph sine, cosine, tangent, and their reciprocals with transformations.
- I can identify amplitude, period, phase shift, and vertical shift.
- I can solve basic trigonometric equations using algebra and inverses.
- I can model real-world periodic behavior (e.g. waves, cycles).

Unit 6: Analytic Trigonometry & Identities

Overview: Students delve into trigonometric identities, sum/difference formulas, double-angle, half-angle, and modeling non-right triangles via Law of Sines and Law of Cosines. This unit unifies algebraic and trigonometric reasoning.

Topic/Theme Duration	FUNCTIONS AND THEIR CHARACTERISTICS APRIL-MAY (3-4 WEEKS)
Focus Question/s	<ul style="list-style-type: none">• Which identity strategies simplify a trig expression?• How do sum/difference and double-angle identities arise from basic definitions?• In what cases do we use Law of Sines vs Law of Cosines?• How do we handle ambiguous cases in triangle solutions?
Standards	<p>F.TF.A.1: Understand radian measure of an angle as arc length on a unit circle.</p> <p>F.TF.A.3: Use special triangles to determine values of sine, cosine, and tangent.</p> <p>F.TF.B.5: Graph trigonometric functions, identifying amplitude, period, phase shift, and midline.</p> <p>F.TF.C.8: Use trigonometric identities to simplify expressions and solve equations.</p>
Key Student Learning Objectives	<p>Students will be able to:</p> <ul style="list-style-type: none">• Work with fundamental trig identities and derive new ones.• Simplify and verify trig expressions.• Use sum/difference, double-angle, and half-angle formulas.• Solve trigonometric equations using identities.• Use the Law of Sines and Cosines to solve general triangles.• Model real-world applications requiring non-right triangle solutions.
Learning Targets	<ul style="list-style-type: none">• I can apply Pythagorean, co-function, and reciprocal identities.• I can use sum and difference formulas, double-angle, and half-angle identities.• I can simplify and verify trigonometric expressions using identities.• I can solve trigonometric equations by applying identities.• I can use the Law of Sines and Law of Cosines to find missing sides/angles.

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| | <ul style="list-style-type: none">• I can handle ambiguous SSA cases and apply them in modeling contexts. |
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Unit 7: Discrete Math, Sequences, Series, and Probability

Overview: In this unit, students extend sequence and series ideas and apply them to discrete mathematics and probability. Topics include combinatorics, the binomial theorem, mathematical induction, and probability models (discrete and continuous).

Topic/Theme Duration	FUNCTIONS AND THEIR CHARACTERISTICS MAY- JUNE (3 WEEKS)
Focus Question/s	<ul style="list-style-type: none">• What distinguishes arithmetic from geometric sequences in behavior and formulas?• When can a series converge, and how do we test it?• How can we count outcomes without listing them?• When and how is the normal distribution a good approximation for binomial models?• Why and how does mathematical induction help us prove formulas?
Standards	<p>F.BF.A.1a: Write a function (recursive or explicit) that describes a sequence.</p> <p>F.IF.A.3: Recognize sequences as functions whose domain is the set of integers.</p> <p>F.LE.A.2: Construct arithmetic and geometric sequences given terms.</p> <p>A.SSE.B.3c: Use the formula for the sum of a finite geometric series.</p> <p>S.ID.A.1–4: Represent and interpret data with histograms, box plots, and scatter plots.</p> <p>S.ID.B.6: Fit a function to data; use residuals to assess model fit.</p> <p>S.IC.A.1–2: Understand and evaluate random processes underlying statistical experiments.</p> <p>S.IC.B.3–6: Make inferences and justify conclusions using sample data.</p>
Key Student Learning Objectives	<p>Students will be able to:</p> <ul style="list-style-type: none">• Work with arithmetic and geometric sequences and series; apply sigma notation and formulas.• Explore binomial expansions and use binomial theorem.• Introduce counting techniques, permutations, combinations, and principles of probability.• Model random variables and use expected value, variance, normal distribution, and binomial approximations.• Apply mathematical induction for proofs in discrete contexts.

Learning Targets

- I can write and analyze sequences using recursive or explicit formulas.
- I can compute finite and infinite sums of series where applicable.
- I can expand using the binomial theorem.
- I can count arrangements and combinations correctly.
- I can compute probabilities, conditional probabilities, and interpret results.
- I can use normal and binomial models to approximate probabilities.
- I can use induction to prove simple statements about sequences.

Unit 8 : Introduction to Calculus / Limits & Derivatives

Overview: This unit introduces the limit concept foundational to calculus. Students explore instantaneous rates of change and area approximations, bridging Precalculus with Calculus concepts.

Topic/Theme Duration	FUNCTIONS AND THEIR CHARACTERISTICS JUNE (2 WEEKS)
Focus Question/s	<ul style="list-style-type: none">• What does it mean for a function to approach a limit?• How does the concept of slope extend to instantaneous rates?• How can we approximate area under curves before integral calculus?
Standards	
Key Student Learning Objectives	Students will be able to: <ul style="list-style-type: none">• Define and estimate limits numerically and graphically.• Interpret average vs. instantaneous rate of change.• Connect secants, tangents, and the notion of a derivative.• Use calculators to approximate derivatives and integrals.
Learning Targets	<ul style="list-style-type: none">• I can approximate limits using tables and graphs.• I can explain the difference between average rate and instantaneous rate of change.• I can sketch secant lines and tangent lines to curves.• I can use technology to estimate derivatives and definite integrals.