Precalculus Year at a Glance

Overview

*In Precalculus, instructional time should focus on **five critical areas**:*

1) **Functions**

Students expand their understanding of functions to include piecewise, logarithmic, and trigonometric functions. Students use composition of functions to identify and find the inverse of a function. They investigate and identify the characteristics of exponential and logarithmic functions in order to graph these functions and solve equations and practical problems. This includes the role of e, natural and common logarithms, laws of exponents and logarithms, and the solutions of logarithmic and exponential equations. Students investigate and identify the characteristics of polynomial and rational functions and use these to sketch the graphs of the functions. They determine zeros (both real and complex), upper and lower bounds, y-intercepts, symmetry, asymptotes, intervals for which the function is increasing or decreasing, and maximum or minimum points. They deepen their understanding of the Fundamental Theorem of Algebra. *Students studying at the honors level study logistic functions, solve for the zeroes of a polynomial using synthetic substitution, and rewrite rational expressions and solve rational equations.*

2) Trigonometry

Students use special triangles positioned within the unit circle to determine geometrically the values of sine, cosine, and tangent at special angles. Students expand their understanding of trigonometric ratios to include secant, cosecant, and cotangent ratios. Students derive the Law of Sines and the Law of Cosines. They use previous knowledge and apply their understanding of the Pythagorean theorem and oblique triangles to discover these formulas and use them to solve problems. Students model periodic phenomena with trigonometric functions. Students expand their understanding of trigonometric functions to include tangent, secant, cosecant, and cotangent. The inverse trigonometric functions are then used to solve trigonometric equations, evaluate their solutions using technology, and interpret these solutions in the appropriate contexts. Students use established trigonometric identities to prove the Pythagorean identities, addition and subtraction identities, and double and half angle identities for sine, cosine, and tangent and use them to solve problems. *Students studying at the honors level derive and apply area formulas for oblique triangles, graph harmonic and inverse trigonometric functions, and engage in more complex trigonometric identity proofs.*

3) Vector and Matrix Quantities

Students learn the utility of representing linear transformations in the two-dimensional coordinate plane via matrices. Students examine the geometric effect of matrix operations—matrix product, matrix sum, and scalar multiplication. Students see that a system of linear equations can be represented as a single matrix equation, and that one can solve the system with the aid of the multiplicative inverse to a matrix if it exists. Students learn the formal definition of a vector and then explore the arithmetical work for vector addition, subtraction, scalar multiplication, and vector magnitude along with the geometrical frameworks for these operations. Students also solve problems involving velocity and other quantities that can be represented by vectors. *Students studying at the honors level view matrices as representing transformations in the plane, develop an understanding of multiplication of a matrix by a vector as a transformation acting on a point in the plane, work with higher dimensional matrices and 3-dimensional vectors, model projectile motion using parametric equations, and develop understanding of complex numbers being represented as vectors in rectangular and polar form on the complex plane.*

4) Analytic Geometry

Students learn the definition of conic sections as cross-sections of a cone and as being defined by geometric properties. Students develop equations to represent conic sections graphed on the coordinate plane and relate the equations to the geometric definitions. Students graph equations of conic sections and

identify key features and properties of each. Students learn the special properties of each conic section and solve real-world problems involving these properties. *Students studying at the honors level will investigate and develop parametric and polar equations to represent conic sections.*

5) Statistics and Probability

Students generalize the multiplication rule for independent events to a rule that can be used to calculate the probability of the intersection of two events in situations where the two events are not independent. Students are also introduced to three techniques for counting outcomes—the fundamental counting principle, permutations, and combinations. These techniques are then used to calculate probabilities, and these probabilities are interpreted in context. Students study probability distributions for discrete random variables. For situations where the probabilities associated with a discrete random variable can be calculated given a description of the random variable, students determine the probability distribution. Students also see how empirical data can be used to approximate the probability distribution of a discrete random variable. Student learn the concept of expected value and calculate and interpret the expected value of discrete random variables in context. Students use probabilities to make a fair decision and analyze simple games of chance as they calculate and interpret the expected payoff in context. They make decisions based on expected values in problems with business, medical, and other contexts. *Students studying at the honors level will relate combinations to Pascal's triangle and develop the Binomial Theorem, deepen understanding of arithmetic and geometric sequences in both explicit and recursive form, define arithmetic and geometric series and develop formulas to compute the sum of finite and infinite series.*

Precalculus Year at a Glance

Unit of Study	Length of Unit	Length of Unit (H)
Unit 1: How Functions Function	**12-14 days**	*10-12 days (H)*
Unit 2: Exponential and Logarithm Functions	**12-14 days**	*10-12 days (H)*
Unit 3: Polynomial and Rational Functions	**14-16 days**	*12-14 days (H)*
Unit 4: Trigonometry Fundamentals	**15-17 days**	*11-13 days (H)*
Unit 5: Trigonometric Functions	**13-15 days**	*15-17 days (H)*
Unit 6: Trigonometric Identities	**Semester Break**	*11-13 days (H)*
	11-13 days	Semester Break
Unit 7: Matrices	**10-12 days**	*10-12 days (H)*
Unit 8 : Vectors	**13-15 days**	*20-22 days (H)*
Unit 9: Conics	**15-18 days**	*20-22 days (H)*
Unit 10: Probability	**13-15 days**	*18-20 days (H)*
TOTAL DAYS of INSTRUCTION	**128-149 days**	*137-157 days (H)*

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
	How Functions Function	**Exponential and Logarithm Functions**	**Polynomial and Rational Functions**	**Trigonometry Fundamentals**	**Trigonometric Functions**	**Trigonometric Identities**	**Matrices**	**Vectors**	**Conics**	**Probability**
	12-14 days *10-12 days (H)*	**12-14 days** *10-12 days (H)*	**14-16 days** *12-14 days (H)*	**15-17 days** *11-13 days (H)*	**13-15 days** *15-17 days (H)*	**11-13 days** *11-13 days (H)*	**10-12 days** *10-12 days (H)*	**13-15 days** *20-22 days (H)*	**15-18 days** *20-22 days (H)*	**13-15 days** *18-20 days (H)*
CCSS Content Standards, Additional Learning Targets, and Math Practices	A-CED.2	A-SSE.3c	N-CN.3 (+)	A-CED.1	A-CED.2	A-SSE.1b	N-VM.6 (+)	*N-CN.3 (+) (H)*	G-C.4 (+)	*A-SSE.4 (H)*
	F-IF.7a	A-CED.2	N-CN.8 (+)	A-CED.4	F-IF.4	A-CED.4	N-VM.7 (+)	*N-CN.4 (+) (H)*	G-GPE.1	*A-APR.5 (+) (H)*
	F-IF.7b	A-REI.11	N-CN.9 (+)	F-TF.1	F-IF.5	AREI.1	N-VM.8 (+)	*N-CN.5 (+) (H)*	G-GPE.2	*F-BF.2 (H)*
	F-IF.7e	F-IF.4	A-SSE.2	F-TF.2	F-IF.7e	F-TF. 8	N-VM.9 (+)	*N-CN.6 (+) (H)*	G-GPE.3 (+)	S-CP.5
	F-IF.9	F-IF.5	A-APR.2	F-TF.3 (+)	F-BF.3	F-TF.9 (+)	N-VM.10 (+)	N-VM.1 (+)	G-GMD.4	S-CP.6
	F-BF.1c (+)	F-IF.7e	A-APR.3	F-TF.4 (+)	F-TF.5	*ALT 6.1 (H)*	N-VM.11 (+)	N-VM.2 (+)	ALT 9.1	S-CP.7
	F-BF.4b (+)	F-BF.3	A-APR.4	G-SRT.7	*F-TF.6 (+) (H)*	*ALT 6.2 (H)*	*N-VM.12 (+) (H)*	N-VM.3 (+)	*ALT 9.2 (H)*	S-CP.8 (+)
	F-BF.4c (+)	F-BF.5 (+)	A-APR.6	G-SRT.8	F-TF.7 (+)	SMP 3	A-REI.8 (+)	N- VM.4a (+)	*ALT 9.3 (H)*	S-CP.9 (+)
	F-BF.4d (+)	ALT 2.1	A-APR.7 (+)	*G-SRT.9 (+) (H)*	ALT 5.1	SMP 6	A-REI.9 (+)	N- VM.4b (+)	*ALT 9.4 (H)*	S-MD.1 (+)
	ALT 1.1 (H)	ALT 2.2	A-REI.2	G-SRT.10 (+)	ALT 5.2		ALT 7.1	N- VM.4c (+)	SMP 6	S-MD.2 (+)
	ALT 1.2 (H)	ALT 2.3	A-REI.11	G-SRT.11 (+)	*ALT 5.3 (H)*		*ALT 7.2 (H)*	N- VM.5a (+)	SMP 7	S-MD.3 (+)
	SMP 6	ALT 2.4	F-IF.7c	ALT 4.1	ALT 5.4		SMP 2	N- VM.5b (+)	SMP 8	S-MD.5a (+)
	SMP 7	ALT 2.5	F-IF.7d (+)	SMP 2	*ALT 5.5 (H)*		SMP 4	*ALT 8.1 (H)*		S-MD.5b (+)
		ALT 2.6 (H)	ALT 3.1	SMP 5	SMP 2		SMP 7	*ALT 8.2 (H)*		S-MD.6 (+)
		ALT 2.7 (H)	*ALT 3.2 (H)*	SMP 7	SMP 4			SMP 4		S-MD.7 (+)
		ALT 2.8 (H)	*ALT 3.3 (H)*	SMP 8	SMP 5			SMP 5		*ALT 10.1 (H)*
		ALT 2.9 (H)	SMP 1							*ALT 10.2 (H)*
		ALT 2.10 (H)	SMP 5							SMP 3
		ALT 2.11 (H)	SMP 7							SMP 4
		SMP 2								
		SMP 4								
		SMP 7								

Seatle Public Schools Additional Learning Targets (ALT) for Precalculus:

Unit 1: How Functions Function

ALT 1.1 (H): Identify the type of function given in a graph or a table.

ALT 1.2 (H): Write linear, exponential, and quadratic functions from two or three points using algebraic techniques or technology.

Unit 2: Exponential and Logarithmic Functions

ALT 2.1: Use the properties of logarithms to transform logarithmic expressions.

ALT 2.2: Use the definition of a logarithm to translate between exponential and logarithmic form, using any base.

ALT 2.3: Use the change of base formula to evaluate logarithms that have bases other than 10 or *e.*

ALT 2.4: Use the definition of a logarithm, properties of logarithms, and the change of base formula to solve equations where the unknown value is an exponent.

ALT 2.5: Write and use logarithmic functions in any base to model real-world phenomena.

ALT 2.6 (H): Build and interpret logistic functions to model real-world pehnomena.

ALT 2.7 (H): Graph and analyze logistic functions.

ALT 2.8 (H): Distinguish between situations that can be modeled with exponential, logarithmic, and logistic functions.

ALT 2.9 (H): Interpret the parameters in a logistic function in terms of a context.

ALT 2.10 (H): Students will identify a logarithmic function given in a graph or a table.

ALT 2.11 (H): Students will write logarithmic functions from two points using algebraic techniques or technology.

Unit 3: Polynomial and Rational Functions

ALT 3.1: Write equations of polynomial functions given complex roots.

ALT 3.2 (H): Calculate limits algebraically and estimate limits from graphs and tables of values.

ALT 3.3 (H): Decompose a fraction with a factorable quadratic denominator and a linear or constant numerator (partial fractions).

Unit 4: Trigonometric Fundamentals

ALT 4.1: Use special triangles to determine geometrically the values of secant, cosecant, cotangent for $\pi/3$, $\pi/4$, and $\pi/6$, and use the unit circle to express the values of sine, cosines, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.

Unit 5: Trigonometric Functions

ALT 5.1: Given a sinusoidal graph, write the related trigonometric function.

ALT 5.2: Graph all trigonometric functions – f(θ) = sin, cos, tan, sec, csc, or cot (θ).

ALT 5.3 (H): Graph inverse trigonometric functions.

ALT 5.4: Link the features of sinusoidoidal graphs to transformations of a sine or cosine parent function.

ALT 5.5 (H): Combine sinusoids through addition or multiplication and graph the resulting combined sinusoid. Given the graph of a combined sinusoid, find the equations of the two sinusoids.

Unit 6: Trigonometric Identities

ALT 6.1 (H): Define and use the relationships between a trig function and its co-function (e.g. secant and cosecant) to establish the co-function identities.

ALT 6.2 (H): Prove that two trigonometric expressions are equivalent using identities.

Unit 7: Matrices

ALT 7.1 : Define the characteristics and properties of matrices.

ALT 7.2 (H): Students will rotate images on the coordinate plane using matrices.

Unit 8: Vectors

ALT 8.1 (H): Find the cross product of 3-D vectors.

ALT 8.2 (H): Write and graph (using technology) parametric equations to represent projectile motion and use them to interpret and predict in context.

Unit 9: Conics

ALT 9.1: Graph Cartesian equations of circles, ellipes, hyperbolas, and parabolas.

ALT 9.2 (H): Write and graph (using technology) parametric equations of conic sections.

ALT 9.3 (H): Understand the relationship between the parametric and Cartesian equations of conic sections.

ALT 9.4 (H): Write and graph polar equations of conic sections.

Unit 10: Probability

ALT 10.1 (H): Derive the formula for the sum of a finite airthmetic series and use the formula to solve problems.

ALT 10.2 (H): Use the formula to find the sum of an infinite geometric series when $|r| < 1$.