Precalculus: Unit 3 – Trigonometric Functions

Topic	Instructional Foci
Topic 1: Special Angles and Reciprocal Trigonometric Functions	In this topic, students learn that the set of trigonometric/circular functions can be extended to the reciprocal functions cotangent, secant, and cosecant and how the characteristics of the cotangent, secant, and cosecant functions can be determined by using the characteristics of the sine, cosine, and tangent functions, respectively. They learn that special triangles can be used to geometrically determine the values of the six trigonometric functions at $\frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}$ and their integral multiples. They also use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for *x*, where *x* is any real number. ***<u>Background:</u>*** In Geometry, students used the sine, cosine, and tangent functions to solve problems involving right triangles and used arc lengths on the unit circle to measure angles in radians. In Algebra 2, students used the unit circle in the coordinate plane to extend the domain of the sine, cosine, and tangent functions to the set of all real numbers. They graphed these functions and analyzed their key features. Students also performed transformations that produced changes in the amplitude, period, and midline of the graphs of the sine and cosine functions. They used trigonometric functions to model circular motion and proved and applied the Pythagorean identity $\sin^2\theta + \cos^2\theta = 1$. ***<u>Concepts:</u>*** 1. Use right triangles to define the secant, cosecant, and cotangent ratios, and use them to solve problems. (Addison Wesley §4.2, , Glencoe §5.2) 2. Find the value of the six trigonometric ratios at $\frac{\pi}{3}, \frac{\pi}{4}$, and $\frac{\pi}{6}$ and their integral multiples. (Addison Wesley §4.2, Glencoe §5.3) 3. Graph functions of the form $f(x) = \sin(bx + c)$. Use trigonometric functions to model periodic phenomena: ebb and flow of tide, blood pressure, temperature fluctuation. (Addison Wesley §4.4, Glencoe §6.7) 4. Graph the cotangent, secant, and cosecant functions and identify key features of the graphs. (Addison Wesley §4.5, Glencoe §6.7)

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Topic 2: Inverse Trigonometric Functions	In this topic, students learn that restricting the domain of a trigonometric function so that it is always increasing or decreasing on an interval allows its inverse to be constructed. ***<u>Background:</u>*** In Algebra 2, students explored inverse functions informally. In Units 1 and 2 of Precalculus, they applied the Inverse Composition Rule to determine if two functions are inverses and learned that one-to-one functions have an inverse that is also a function. When functions were not one-to-one, students learned to restrict the domain so the inverse will be a function. ***<u>Concepts:</u>*** 1. Construct the inverses of the sine, cosine, and tangent functions by restricting their domains. (Addison Wesley §4.7, Glencoe §6.8) 2. Use trigonometric functions to model the motion of objects that oscillate, vibrate, or rotate. (Addison Wesley §4.8, Glencoe §6.8)

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Topic 3: Trigonometric Identities and Equations	In this topic, students learn that trigonometric expressions can be rewritten using sum and difference, double, half-angle, and Pythagorean identities. They learn that trigonometric identities can be proven using graphs and basic identities (reciprocal, sum and difference, double, half-angle, and Pythagorean). They choose trigonometric equations to model real-world situations including amplitude, period, midline, and phase shift and use inverse functions to solve trigonometric equations that arise from a context. ***Background:*** In C2.0 Geometry, students explored relationships between values of trigonometric ratios. Honors Geometry students developed, proved, and applied the Pythagorean identity $\cos^2\theta+\sin^2\theta=1$ where θ is the measure of an angle in a right triangle. In C2.0 Algebra 2, students extended the Pythagorean Identity to all real values of θ. ***Concepts:*** 1. Develop, state, and apply the fundamental identities, including reciprocal and quotient, Pythagorean, co-function, and odd/even identities. (Addison-Wesley §5.1, Glencoe §7.1, §7.5) 2. Prove trigonometric identities. (Addison-Wesley §5.2, Glencoe §7.2) 3. Develop, prove, and apply the sum and difference identities for sine, cosine, and tangent. (Addison-Wesley §5.3, Glencoe §7.3, §7.5) 4. Develop, prove, and apply the double-angle and half-angle formulas for sine and cosine. (Addison-Wesley §5.4, Glencoe §7.4, §7.5)

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Topic 4: Laws of Sines and Cosines	In this topic, students learn that unknown measurements of non-right triangles can be found using the Laws of Sines and Cosines. Honors students also learn that when the measurements of two sides and an angle that is not between them (SSA) are given, there may be two possible triangles, and the Law of Sines can be used to find the unknown measurements of both. ***<u>Background:</u>*** In C2.0 Geometry, students used trigonometric ratios to solve problems involving right triangles. Honors Geometry students developed, proved, and applied the Laws of Sines and Cosines, and the area formula for a triangle given two sides and the angle between them. They did not address the ambiguous case of the Law of Sines, where two sides and the angle not between them are given and 0, 1, or 2 triangles are possible. ***<u>Concepts:</u>*** 1. Derive and apply the Law of Sines (Addison-Wesley §5.5, Glencoe §5.6) 2. Explore the ambiguous case for Law of Sines. (Addison-Wesley §5.5, Glencoe §5.7) 3. Derive and apply the Law of Cosines. (Addison-Wesley §5.6, Glencoe §5.8) 4. Derive and apply triangle area formulas. (Addison-Wesley §5.6, Glencoe §5.6, §5.8)