Unit 5: Trigonometric Ratios

Content Area: **Mathematics**
Course(s): **Algebra 3CP**
Time Period: **Semester 2**
Length: **4 weeks**
Status: **Published**

Unit Description

This unit develops students' understanding of trigonometry through the study of right triangles, trigonometric functions, the unit circle, inverse trigonometric functions, and coordinate plane applications. Students begin by exploring the Pythagorean Theorem and the trigonometric ratios of sine, cosine, and tangent within right triangles. They then extend their understanding to solving right triangles, applying inverse trigonometric functions, and solving real-world application problems involving indirect measurement and modeling. The unit progresses to the study of angles of rotation, coterminal angles, reference angles, radian measure, and the unit circle, enabling students to understand trigonometric functions beyond right triangles. Students further investigate trigonometric ratios on the unit circle, evaluate inverse trigonometric functions, analyze points on the terminal side of angles, and use radius (r) and angle measure (θ) to determine points in the coordinate plane. Throughout the unit, students develop mathematical reasoning, problem-solving skills, and the ability to apply trigonometric concepts to authentic situations while building confidence through visual, numerical, algebraic, and graphical representations.

Enduring Understandings

Students will understand that:

- The Pythagorean Theorem establishes a fundamental relationship among the sides of a right triangle.
- Trigonometric ratios describe predictable relationships between angles and side lengths in right triangles.
- Sine, cosine, tangent, and their inverse functions are powerful tools for solving mathematical and real-world problems.
- Angles can be measured in both degrees and radians, and each measurement system serves important purposes.
- The unit circle provides a geometric representation of trigonometric functions, and extends trigonometry beyond right triangles.
- Trigonometric functions can be represented numerically, graphically, algebraically, and geometrically.
- Mathematical models help explain and solve real-world situations involving distance, height, navigation, and rotational motion.
- Multiple representations support deeper understanding of mathematical concepts and relationships.

Essential Questions

How can the ratios of the sides in special right triangles help us solve trigonometry problems in different

contexts?

How does the Pythagorean Theorem help describe relationships within right triangles?

What do sine, cosine, and tangent represent, and how are they used to solve problems?

How can inverse trigonometric functions be used to determine unknown angle measures?

How does trigonometry help solve real-world measurement and modeling problems?

What are angles of rotation, coterminal angles, and reference angles, and why are they important?

How are degrees and radians related?

How does the unit circle extend our understanding of trigonometric functions?

What patterns and relationships exist among trigonometric values on the unit circle?

How do inverse trigonometric functions connect angles and trigonometric ratios?

How can points on the terminal side of an angle be used to determine trigonometric ratios?

How can radius (r) and angle measure (θ) be used to locate points in the coordinate plane?

How do trigonometric concepts connect geometry, algebra, and real-world applications?

Standards

MA.G-SRT.C.6	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
MA.G-SRT.C.7	Explain and use the relationship between the sine and cosine of complementary angles.
MA.G-SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
MA.F-TF.A.1	Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
MA.F-TF.A.2	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
MA.F-TF.A.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/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.
MA.F-TF.B.7	Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

Transfer Goals

Students will independently use geometric and trigonometric reasoning to solve authentic problems involving measurement, location, navigation, design, engineering, and other real-world contexts. They will transfer their

understanding of right-triangle relationships, trigonometric functions, inverse functions, unit-circle concepts, and coordinate representations to unfamiliar situations requiring mathematical modeling and critical thinking. Students will recognize when trigonometric tools provide efficient solutions and will apply multiple representations to analyze, communicate, and justify mathematical conclusions across academic, workplace, and everyday settings.

Resources

Intermediate Algebra with Applications 5/6th ed by Aufmann/Barker/Lockwood]

Online resources which include, but are not limited to: Desmos Graphing Calculator, Class Kick, Delta Math, Khan Academy, and CK-12 Foundation's Algebra 2 with Trigonometry Concepts by CK-12/Gloag/ Rawley, last modified April 12, 2024

Knowledge and Skills

- use the Pythagorean Theorem along with trigonometric functions and inverse trigonometric functions to find missing sides of right triangles.
- use the ratios of the sides of special right triangles to find missing sides of the special triangles.
- do trigonometry on calculators to find missing sides and angles of right triangles.
- apply trigonometry to word problems involving angles of elevation and depression.
- draw and use the coordinates of special right triangles in the coordinate plane to find missing sides of triangles.
- evaluate trigonometric functions of quadrantal angles.
- apply signs of trigonometric functions in the coordinate plane to draw triangles and find missing sides.
- evaluate sides of special right triangles when given angle measures in radians by first converting to degrees and then solving.