09 Trigonometric Relationships and Functions

Content Area: **TEMPLATE**
Course(s):
Time Period: **Full Year**
Length: **4 - 5 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This course is an extension of Algebra 1. Emphasis is upon the development of insights into the structure of algebra as a deductive process. The content includes function foundations, equations and inequalities, polynomial functions and equations, rational functions and equations, radical expressions and equations, exponential and logarithmic functions and equations, trigonometric functions and equations, introductory data analysis, and probability.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives:

- Trigonometric relationships are applied to both triangles and unit circles
- Trigonometric functions model periodic behavior
- Significance of trigonometric ratios within triangles

Essential Questions:

- How are angles and trig ratios represented in the x-y coordinate plane?
- Why are radian measures used rather than degree measures in working with trigonometric functions and their applications?
- How can you model periodic behavior?
- How does the analysis of the unit circle generate right triangle ratios?
- Why are trigonometric functions periodic?
- How does the periodic nature of the trigonometric functions help to solve problems? problems?
- How is trigonometry useful in modeling real life situations that deal with right triangles?

Enduring Understanding:

- Trigonometric functions can be applied to areas of study involving periodic behavior
- Angles can be measured in different units
- Trigonometric functions describe periodic phenomenon
- Trigonometry is useful in modeling and solving real-life problems that involve right angles.

CONTENT AREA STANDARDS

F.LE

A. Construct and compare linear and exponential models and solve problems

B. Interpret expressions for functions in terms of the situation they model

F.TF

A. Extend the domain of trigonometric functions using the unit circle

B. Model periodic phenomena with trigonometric functions

C. Prove and apply trigonometric identities

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.G-SRT.D.9	Derive the formula A = (1/2)$ab\ sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
MA.G-SRT.D.10	Prove the Laws of Sines and Cosines and use them to solve problems.
MA.G-SRT.D.11	Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).
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 π – x, π + x, and 2π – x in terms of their values for x, where x is any real number.
MA.F-TF.A.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
MA.F-TF.B.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
MA.F-TF.B.6	Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
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.
MA.F-TF.C.8	Prove the Pythagorean identity sin^2(θ) + cos^2(θ) = 1 and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle.
MA.F-TF.C.9	Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

9.1.8.PB.1: Predict future expenses or opportunities that should be included in the budget planning process.

PFL.9.1.K12.P.4	Demonstrate creativity and innovation.
PFL.9.1.K12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
PFL.9.1.K12.P.6	Model integrity, ethical leadership and effective management.
PFL.9.1.K12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
PFL.9.1.K12.P.9	Work productively in teams while using cultural/global competence.
LA.K-12.NJSLSA.R7	Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
CS.K-12.4.a	Extract common features from a set of interrelated processes or complex phenomena.
CS.K-12.4.c	Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.
CS.K-12.4.d	Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.

STUDENT LEARNING TARGETS

Refer to the 'Declarative Knowledge' and 'Procedural Knowledge sections.

Declarative Knowledge

Students will understand that:

- The Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles
- Restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed
- Radian measure of an angle as the length of the arc on the unit circle subtended by the angle
- By similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

Procedural Knowledge

Students will be able to:

- Derive the formula $A = 1/2\ ab\ \sin(C)$ for the area of a triangle
- Prove the addition and subtraction formula for sine, cosine, and tangent and use them to solve problems
- Prove the Laws of Sines and Cosines and use them to solve problems
- Prove the Pythagorean Identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle
- Use special triangles to determine geometrically the value of sine, cosine, tangent for $\pi/3$, $\pi/4$, and $\pi/6$
- Explain and use the relationship between the sine and cosine of complementary angles
- Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures
- 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
- Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions
- Use the unit circle to express the values of sine, cosine, and tangent for ? - x, ? + x, and 2? -x in terms of their values for x, where x is any real number
- Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline
- Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems
- Apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles

EVIDENCE OF LEARNING

Refer to the 'Formative Assessments' and 'Summative Assessments' sections.

Benchmark Assessments

Benchmark Assessments conducted three times per year, using Pear Assessment (Standards Based Assessments)

Alternate Assessments

- Portfolios

- Verbal Assessment (instead of written)
- Multiple choice
- Modified Rubrics
- Performance Based Assessments

Formative Assessments

- Class Discussion
- Teacher observation
- Exit/Entrance Tickets
- Classwork
- Homework

Summative Assessments

- Quizzes
- Test
- Projects

RESOURCES (Instructional, Supplemental, Intervention Materials)

Core Instructional Materials

- Sullivan Algebra and Trigonometry Textbook (Chapter 7 - 9)

Supplemental Materials

- Khan Academy
- Deltamath
- Illustrative Mathematics Tasks by standard
- Illustrative Mathematics Curriculum
- Trigonometric Identities
- Desmos
- Trigonometry Mini Golf

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations such as navigation, surveying, sound waves, and tides. Examples can be found in topic specific textbook problems and digital resources.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.