FST Unit 2 - Trigonometry and Periodic Functions

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **60**
Status: **Published**

Unit Overview

Unit Summary	Unit Rationale
Students start by applying right-triangle trigonometry to all triangles with the Law of Sines and Law of Cosines. They then learn about radian measure and the unit circle, including exact trigonometric values and the Pythagorean identity. Next, the unit covers how to graph all six trigonometric functions and find the amplitude, period, midline, and phase shift. Finally, students use sinusoidal models to represent real-world periodic phenomena such as circular motion, tides, and sound.	Trigonometry connects the study of shapes with the study of movement and patterns. In high school math, this unit helps students transition from basic algebra to more advanced topics such as modeling, calculus, and real-world science. Learning this sequence helps students understand both space and time by looking at math in three main ways: Students learn to work with all kinds of triangles, not just right triangles, by using the Law of Sines and Law of Cosines. Choosing and using the right trigonometric tools builds spatial reasoning and problem-solving skills that are important in navigation, surveying, architecture, physics, and engineering. When students switch from degrees to radians and use right triangles on the Unit Circle, they begin to see trigonometric ratios as continuous functions rather than just side-length comparisons. Learning about special angles, symmetry, Pythagorean identities, and all six trigonometric ratios helps them build the algebra skills and theory they need for calculus. Nature and technology are full of repeating patterns, like tides, sound waves, changing daylight, orbits, and electrical currents. By learning to graph sinusoidal functions and build trigonometric models, students see how math describes cycles. This helps them analyze patterns, understand real-world situations, and make accurate predictions. This unit makes trigonometry practical, giving students tools to study shapes, model natural cycles, and prepare for future STEM classes.

NJSLS

G.C.B.5	Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.
F.BF.B.3	Identify the effect on the graph of replacing □(□) by □(□) + □, □ □(□), □(□□), and □(□ + □) for specific values of □(both positive and negative); find the value of □ given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.
F.IF.C.7.f	Graph trigonometric functions, showing period, midline, and amplitude.
F.TF.A.1	Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
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.
F.TF.A.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for □/3, □/4 and □/6, and use the unit circle to express the values of sine, cosine, and tangent for □ – □, □ + □, and 2□ – □ in terms of their values for □, where □ is any real number.
F.TF.A.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
F.TF.B.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
G.SRT.D.9	Derive the formula □ = 1/2 □□ sin(□) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
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).
F.TF.C.8	Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ 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.

Standards for Mathematical Practice

1	Make sense of problems and persevere in solving them
2	Reason abstractly and quantitatively
3	Construct viable arguments and critique the reasoning of others
4	Model with mathematics
5	Use appropriate tools strategically
6	Attend to precision
7	Look for and make use of structure
8	Look for and express regularity in repeated reasoning

Unit Focus

Enduring Understandings	Essential Questions
• The Law of Sines and the Law of Cosines allow us to use right-triangle trigonometry with any triangle. • Radian measure links angle measure to arc	• How can we use the Law of Sines and the Law of Cosines to solve triangles that are not right triangles, and how do we decide which law to apply?

length, so it is the standard unit for trigonometric functions on all angles, not just acute ones. • Four main features shape the graph of a trigonometric function: amplitude, period, midline, and phase shift. • We can model real-world cycles such as tides, sound, or circular motion with sinusoidal functions by determining the amplitude, midline, and frequency from the situation.	• Why do mathematicians often prefer radians over degrees when working with advanced trigonometric functions? • How does changing each part of a sinusoidal equation affect the way its graph looks? • What clues in a real-world repeating process help you choose the right sinusoidal model?

Instructional Focus

Learning Targets

Lesson 8 — Applied Right Triangle Geometry

- I can use SOH-CAH-TOA to find a missing side or angle in a right triangle, including angle of elevation/depression problems.
- I can find the area of any triangle when I know two sides and the angle between them.
- I can use the Law of Sines to find a missing side or angle when I know two angles and a side.
- I can recognize when a Law of Sines problem might have two possible answers (the ambiguous case) and find both.
- I can use the Law of Cosines to find a missing side or angle when I know three sides, or two sides and the angle between them.
- I can choose the right tool to solve real-world problems in surveying and navigation.

Lesson 9 — Radian Measure and the Unit Circle

- I can convert an angle between degrees and radians.
- I can find the length of an arc and the area of a sector using radian measure.
- I can find the coordinates of any point on the unit circle and use them to define sine and cosine for any angle.
- I can find the exact sine, cosine, and tangent values for the special angles $\pi/3$, $\pi/4$, and $\pi/6$.
- I can use a reference angle to find the exact trig value of any angle on the unit circle.
- I can use the symmetry of the unit circle to find trigonometric values for angles such as $\pi + x$ and $2\pi - x$.
- I can tell whether sine, cosine, and tangent are even or odd functions, and explain why trig functions repeat.
- I can identify and evaluate all six trig functions — sine, cosine, tangent, cotangent, secant, cosecant — using the unit circle.
- I can prove and explain the Pythagorean identity $\sin^2\theta + \cos^2\theta = 1$.
- I can use the Pythagorean identity to find a missing trigonometric value when I know one ratio and the angle's quadrant.

- I can find all six trigonometric function values for an angle when I know only one ratio and its quadrant.

Lesson 10 — Graphing Trigonometric Functions

- I can graph $y = \sin(x)$ and $y = \cos(x)$ and identify their key points and period.
- I can explain how changing "A" in $y = A \sin(x)$ changes the amplitude of the graph.
- I can explain how changing "B" in $y = \sin(Bx)$ changes the period of the graph.
- I can identify the midline and phase shift of a sine or cosine graph.
- I can graph a sine or cosine function that combines amplitude, period, midline, and phase shift all at once.
- I can find the period, midline, amplitude, and phase shift from either an equation or a graph.
- I can write the equation of a sine or cosine function just by looking at its graph.
- I can graph $y = \tan(x)$ and its transformations, including its asymptotes.
- I can graph secant, cosecant, and cotangent functions.
- I can sketch a trig graph that models a real-world periodic situation described in words.

Lesson 11 — Modeling Periodic Phenomena

- I can decide which trig function best models a real-world periodic situation and identify its amplitude, midline, and frequency from the context.
- I can write a sine or cosine equation that models a real-world periodic situation.
- I can use a sinusoidal model to make a prediction about a real-world situation (e.g., a Ferris wheel, tides, daylight hours, sound waves).
- (Enrichment, if time) I can use the sum and difference formulas to find exact trig values and solve problems.

Prerequisite Skills

- Right-triangle trigonometric ratios (SOH-CAH-TOA) and solving right triangles (Geometry)
- The Pythagorean Theorem (Geometry)
- Graphing and transforming parent functions — $f(x)+k$, $k \cdot f(x)$, $f(kx)$, $f(x+k)$ (Unit 1, Lesson 2)
- Circle vocabulary: radius, arc, central angle, sector (Geometry)
- Degree measure of special angles — 30°, 45°, 60°, 90° (Geometry)

Common Misconceptions

- Students often reach for the Law of Sines or Cosines in right triangles when simpler ratios would suffice, or fail to recognize when a non-right-triangle tool is actually required.
- Students frequently forget that the ambiguous case (SSA) can produce zero, one, or two valid triangles.
- Students often treat radians and degrees as interchangeable quantities rather than distinct units, leading to errors when the two are mixed in a calculation.
- Students often confuse the effect of B (period) with the effect of A (amplitude) in $y = A \sin(B(x - C)) + D$.
- Students may think a negative sine or cosine value signals an error rather than a normal result of the unit circle's coordinate signs in Quadrants II–IV.

Spiraling For Mastery

Current Unit Content/Skills	Spiral Focus	Activity
Function transformations (Unit 1, Lesson 2): f(x)+k, k·f(x), f(kx), f(x+k)	Directly reapplied to graph sine/cosine transformations in Lesson 10	Warm-up at the start of Lesson 10: revisit the four transformation types on a non-trig function before introducing trig graphing
Key features of graphs (Unit 1, Lessons 2, 4, 5)	Reapplied to identify amplitude, period, and midline as the trig-specific version of "key features"	Warm-up comparing the key features of a polynomial graph to those of a trig graph
Solving equations graphically with technology (Unit 1, Lesson 7)	Reused to solve trigonometric equations graphically	Include one "solve graphically" trig equation on the Lesson 10 or 11 quiz
Right-triangle trigonometry (Geometry prerequisite)	Extended to the Law of Sines/Cosines in Lesson 8	Diagnostic warm-up on Lesson 8, Day 1 checking SOH-CAH-TOA fluency before extending to non-right triangles
Choosing a model to fit a context (Lesson 11, periodic modeling)	Spirals forward into Unit 3, Lesson 14 (Linear Regression), where students choose among linear/quadratic/exponential models for data	Opening discussion in Unit 3, Lesson 14 referencing how Lesson 11 chose a sinusoidal model the same way Lesson 14 chooses a function family

Assessment

Formative Assessment	Summative Assessment
• Homework • Lesson Checks • Quizzes • Exit Tickets • Lesson Reflections • Performance Tasks	• Topic Tests and Quizzes • Benchmark 2 (Link-it) - Covers Unit 1, Lesson 6 - 7 and Unit 2, Lessons 8 - 9 • Benchmark 3 (Link-it) - Covers Unit 2, Lesson 10 - 11 and Unit 3, Lessons 12 - 13

Resources

Key Resources	Supplemental Resources
Saavas Algebra 2 Math Medic	iXL Delta Math Desmos Khan Academy Math Medic Skew the Script Teacher-made worksheets FST Pacing Guide

Career Readiness, Life Literacies, and Key Skills

9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).

Interdisciplinary Connections

HS-PS2-4	Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects.
HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.