Unit 3 Trigonometric and Polar Functions

Content Area: **Mathematics**
Course(s):
Time Period: **February**
Length: **10 weeks**
Status: **Published**

Unit Overview:

In Unit 3, students explore trigonometric functions and their relation to the angles and arcs of a circle. Since their output values repeat with every full revolution around the circle, trigonometric functions are ideal for modeling periodic, or repeated pattern phenomena, such as: the highs and lows of a wave, the blood pressure produced by a heart, and the angle from the North Pole to the Sun year to year. Furthermore, periodicity is found in human inventions and social phenomena. For example, moving parts of an analog clock are modeled by a trigonometric function with respect to each other or with respect to time; traffic flow at an intersection over the course of a week demonstrates daily periodicity; and demand for a particular product over the course of a year falls into an annually repeating pattern. Polar functions, which are also explored in this unit, have deep ties to trigonometric functions as they are both based on the circle. Polar functions are defined on the polar coordinate system that uses the circular concepts of radii and angles to describe location instead of rectangular concepts of left-right and up-down, which students have worked with previously. Trigonometry serves as the bridge between the two systems.

Enduring Understandings:

- Basic properties of trig graphs can be linked to a deep understanding of the unit circle and fundamental trig identities.
- Changes to the algebraic equation of a function cause predictable changes to the function's graph. - Basic pr
- Polar coordinates are an alternative way to specify location on the plane
- The symmetry of the unit circle allows trig equations to often have multiple answers.
- Trig equations can be treated like much more basic equations by using the concept of substitution.
- Trig identities allow us to express trig expressions in different, but equivalent ways.

Career Education Connection

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Essential Questions:

- How do we model aspects of circular and spinning objects without using complex equations from the x-y rectangular-based coordinate system?
- How does right triangle trigonometry from geometry relate to trigonometric functions?
- Since energy usage goes up and down through the year, how can I use trends in data to predict my monthly electricity bills when I get my first apartment?

Standards/Indicators/Student Learning Objectives (SLOs):

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.F-TF.A	Extend the domain of trigonometric functions using the unit circle
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.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
MA.F-TF.B	Model periodic phenomena with 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	Prove and apply trigonometric identities
MA.F-TF.C.8	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.
MA.F-TF.C.9	Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

Lesson Titles:

- 3.1 Periodic Phenomena
- 3.10 Trigonometric Equations and Inequalities
- 3.11 The Secant, Cosecant, and Cotangent Functions
- 3.12 Equivalent Representations of Trigonometric Functions
- 3.13 Trigonometry and Polar Coordinates
- 3.14 Polar Function Graphs
- 3.15 Rates of Change in Polar Functions
- 3.2 Sine, Cosine, and Tangent

- 3.3 Sine and Cosine Function Values
- 3.4 Sine and Cosine Function Graphs
- 3.5 Sinusoidal Functions
- 3.6 Sinusoidal Function Transformations
- 3.7 Sinusoidal Function Context and Data Modeling
- 3.8 The Tangent Function
- 3.9 Inverse Trigonometric Functions

Diversity, Equity, and Inclusion

Amistad Mandate

Topic:

Materials Used:

Addresses the Following Component of the Mandate:

- African Slave Trade
- Amistad
- Contributions of African Americans to our Society
- Slavery in America
- Vestiges of Slavery in this Country

Holocaust Mandate

Topic:

Materials Used:

Addresses the Following Component of the Mandate:

- Bias

- Bigotry
- Bullying
- Holocaust Studies
- Prejudice

LGBTQ and Disabilities Mandate

Topic (Person and Contribution Addresses):

Materials Used:

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

Climate Change

Asian American Pacific Islander Mandate

Topic (Person and Contribution Addresses):

Materials Used:

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

Inter-Disciplinary Connections:

9-12.HS-ETS1-4.5.1	Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.
9-12.HS-ETS1-2.6.1	Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Modifications

MLL Modifications:

- Choice of test format (multiple-choice, essay, true-false)
- Continue practicing vocabulary
- Provide study guides prior to tests
- Read directions to the student
- Read test passages aloud (for comprehension assessment)
- Vary test formats

G&T Modifications:

- Alternate assignments/enrichment assignments
- Enrichment projects
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments
- Tiered centers

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be considered:

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples

- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments
- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Use of a graphic organizer

- Use of concrete materials and objects (manipulatives)
- Use of word processor

Assessments

Summative Assessment:

- Alternate Assessment
- AP Practice Exam
- Benchmark
- Marking Period Assessment

Benchmark Assessments

Writing Prompt

Skills Based Assessment

Reading Response

- Final
- Midterm

Alternative Assessment

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Formative Assessment:

- Anticipatory Set
- Closure
- Warm-Up

Computer Science and Design Thinking Standards

CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.

Career Readiness, Life Literacies, & Key Skills:

WRK.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.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.

Materials:

Core Instructional Materials

Supplemental Materials

Texts at Various Levels

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Circuits

- Complete Progress check
- Define coterminal, reference, quadrantal angles
- Define period, amplitude, and interval
- Define Periodic Function
- Define principal value
- Define Radian
- Demonstrate converting polar coordinates and equations into rectangular
- Demonstrate converting rectangular coordinates and equations into polar
- Demonstrate how to graph sine and cosine functions
- Group work at White board
- Intro chart for 30,45, 60
- Intro Cosecant, secant, and cotangent
- Intro inverse of trig functions
- Intro Polar coordinate system and how to plot
- Intro Polar graphs
- Intro rates of change in polar equations
- Intro Sinusoidal Function Context and Data Modeling - real world application
- Intro solving trig equations
- Intro solving trig inequalities
- Intro Tangent Function and its graph
- Intro Unit Circle
- Look over sample free response student responses and scoring
- practice AP free response questions
- practice AP multiple choice questions
- Practice constructing a periodic phenomena
- Practice graphing sine and cosine functions by hand and graphing calcualator
- review homework
- thin slicing lesson
- Translate Trig function graphs

Technology Materials and Standards

- AP Classroom site
- Calc Medic Videos
- Flipped Math Videos
- Google Classroom
- Google Slides
- Graphing Calculator
- IXL

TECH.8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.C.CS3	Develop cultural understanding and global awareness by engaging with learners of other cultures.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.