MATHEMATICS COMMON CORE CURRICULUM UNIT #4 Algebra 2*
North Smithfield School Department

TITLE OF UNIT: Unit 4 Trigonometric Functions_____   **COURSE OR GRADE :** Algebra 2

DATE PRESENTED: _____ **DATE DUE:** _____ **LENGTH OF TIME:** several weeks, quarter, semester

OVERVIEW OF UNIT:

Unit 4 standards will focus on extending the domain of trigonometric functions using the unit circle, modeling periodic phenomena with trigonometric functions, and proving and applying trigonometric identities.

> **ESSENTIAL QUESTION, PROMPT, PROBLEM/UNIT**

STANDARDS: Common Core Math Standards – Grade level Categories 9-12

Number and Quantity	Algebra	Functions	Modeling	Geometry	Statistics and Probability
☐ The Real Number System N-RN	☐ Seeing Structure in Expressions A-SSE	☐ Interpreting Function F-If	☐	☐ Congruence G-CO	☐ Interpreting Categorical and Quantitative Data S-ID
☐ Quantities N-Q	☐ Arithmetic with Polynomials and Rational Expressions A-APR	☐ Building Functions F-BF	☐	☐ Similarity, Right Triangles, and Trigonometry G-SRT	☐ Making Inferences and Justifying Conclusions S-IC
☐ The Complex Number System N-CN	☐ Creating Equations A-CED	☐ Linear, Quadratic, and Exponential Models F-LE		☐ Circles G-c	
☐ Vector and Matrix Quantities N-VM	☐ Reasoning with Equations and Inequalities A-REI	☐ Trigonometric Functions F-TF		☐ Expressing Geometric Properties with Equations G-GPE	
☐	☐	☐		☐ Geometric Measurement and Dimensions G-GMD	
☐	☐	☐		☐ Modeling with Geometry G-MG	

STANDARDS: Mathematical Practices grades K-12

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

FOCUS MATHEMATICS STANDARDS:

- Extend the domain of trigonometric functions using the unit circle. F.TF.1,2
- Model periodic phenomena with trigonometric function. F.TF.5
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- Prove and apply trigonometric identities. F.TF.8
- Analyze functions using different representations. F.IF. 7e, 9 (θ), cos(θ), or tan(θ) and the quadrant of the angle. F.TF.8

Applied Learning Standards:
problem solving   communication   critical thinking   research   reflection/ evaluation

Expectations for Student Learning (High School only):
Problem Solving, Communication, Body of Knowledge, Responsibility

ENDURING UNDERSTANDING:

At the end of this unit, students will be proficient in the following:

- Understand the meaning and find the measure of an angle of rotation as it relates to the unit circle.
- Evaluate the value of the sine, cosine, and tangent functions using the unit circle.
- Graph simple trigonometric functions by hand (sine, cosine, and tangent), and more complex functions using technology.

- Determine the period, amplitude, and midline of the sine, cosine, and tangent functions.
- 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.

## PRIOR KNOWLEDGE:
Algebra 1 and Geometry

STUDENT OBJECTIVES, SKILLS and/or NEW KNOWLEDGE:

- The unit circle is a circle with radius of length 1 centered at the origin.
- The radian measure of an angle is the length of the arc on the unit circle subtended by the angle.
- Angles on the unit circle are measured counterclockwise from the point (1, 0).
- Trigonometric functions can be extended to the domain of all real numbers using the unit circle.
- Trigonometric functions can be used to model periodic phenomena.
- In order to model a periodic phenomenon, you need to know the amplitude, frequency or period, and midline.
- The Pythagorean identity states that $\sin^2\theta + \cos^2\theta = 1$.
- The Pythagorean identity can be used to find $\sin\theta$, $\cos\theta$, or $\tan\theta$ given one of those quantities and the quadrant of the angle.
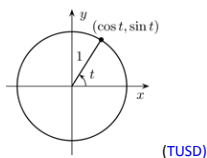- Graph sine, cosine, and tangent functions.

SUGGESTED PROBLEMS:

Teaching Examples F.TF.1

- What is the radian measure of the angle t in the diagram below?
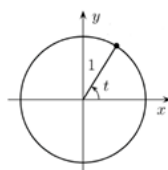
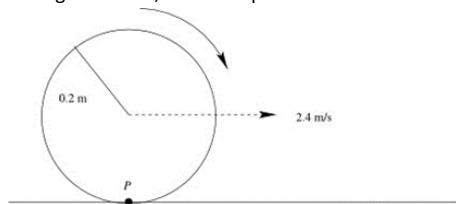

Teaching Examples F.TF.2

- The coordinates (x, y) of any point on the unit circle are given by $x = \cos t$, $y = \sin t$, where t is the radian measure of the angle from the positive x-axis.

(TUSD)

Teaching Examples F.TF.5
Example:

- The temperature of a chemical reaction oscillates between a low of 20°C and a high of 120°C. The temperature is at its lowest point when $t = 0$ and completes one cycle over a six-hour period.

    a. Sketch the temperature, T, against the elapsed time, t, over a 12-hour period.
    b. Find the period, amplitude, and the midline of the graph you drew in part (1).
    c. Write a function to represent the relationship between time and temperature.
    d. What will the temperature of the reaction be 14 hours after it began?
    e. At what point(s) during a 24-hour day will the reaction have a temperature of 60°C?

- A wheel of radius 0.2 meters begins to move along a flat surface so that the center of the wheel moves forward at a constant speed of 2.4 meters per second. At the moment the wheel begins to turn, a marked point P on the wheel is touching the flat surface.

    Write an algebraic expression for the function y that gives the height (in meters) of the point P, measured from the flat surface, as a function of t, the number of seconds after the wheel begins moving.
    From http://illustrativemathematics.org   (TUSD)

Teaching Examples F.TF.8

- Prove the Pythagorean identity.

*Referenced templates from Common Core Curriculum Maps, English Language Arts and The Understanding By Design Guide to Creating High Quality Units

- Given that $\cos\theta = \dfrac{\sqrt{3}}{2}$ and $\dfrac{3\pi}{2} < \theta < 2\pi$, find the values of sin(θ) and tan(θ) . (TUSD)

Assessment Problems

F-TF.1
http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-1.html

F-TF.2
http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-2.html

F-TF.5
http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-5.html

F-TF.8
http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-8.html

ACTIVITIES, PRODUCTS, PERFORMANCE, and ASSESSMENTS: see curriculum introduction

1. Application to real world problems
2. Creating charts/collecting data
3. Collaboration - interpersonal
4. Conferencing
5. Exhibits
6. Graphic organizers
7. Graphing
8. Interviews
9. Journals
10. KWL charts
11. Mathematical Practices
12. Modeling ★
13. Oral presentations
14. Problem/Performance based/common tasks
15. Real-life applications involving graphing
16. Represent numbers
17. Rubrics/checklists (mathematical practice, modeling)
18. Technology
19. Summarizing and note-taking
20. Tests and quizzes
21. Writing genres Arguments/ opinion Informative

- Warm ups
- Unit assessments
- Semester/End of course exams

HIGHER ORDER THINKING SKILLS: **Web's Depth of Knowledge 2 – 4 or Bloom's Taxonomy**

Web's Depth of Knowledge

- skill/conceptual understanding
- strategic reasoning
- extended reasoning

Bloom's Taxonomy

- apply
- analyze
- synthesize/create
- evaluate

ADDITIONAL RESOURCES: see curriculum for specifics

Textbook
- *Algebra 2, McDougal Littell 2004*
- *Explorations, Holt McDougal*

Technology
- Computer lab
- Computer software that generate graphs of functions
- Computers
- Document camera
- Graphing calculator
- Graphing software
- Interactive boards
- LCD projectors
- Overhead graphing scientific

*Referenced templates from Common Core Curriculum Maps, English Language Arts and The Understanding By Design Guide to Creating High Quality Units

Websites

- http://curriculum.northsmithfieldschools.com
- http://www.achieve.org/http://my.hrw.com
- http://www.illustrativemathematics.org/standards/practice
- http://www.ixl.com/standards/common-core/math/grade-8
- http://www.ixl.com/standards/common-core/math/high-school
- http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDefaultPage.aspx?page=1
- http://www.ode.state.or.us/search/page/?id=3747
- http://www.parcconline.org/sites/parcc/files/PARCC%20Math%20S
- http://www.schools.utah.gov/CURR/mathsec/Core.aspx
- http://www.tusd1.org/contents/distinfo/curriculum/index.asp
- www.commoncore.org/maps
- www.corestandards.org
- www.khanacademy.com
- www.ride.ri.gov

Materials

- Tables, graphs and equations of real-world applications that apply quadratic and exponential functions

VOCABULARY

Academic vocabulary

- Amplitude
- Cosine
- Frequency
- Midline
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- Oscillation
- Period
- Periodic function
- Pythagorean Identity
- Radian measure

- Sine
- Tangent
- Trigonometric function
- Unit circle

LESSON PLAN for UNIT _____

LESSONS

- **Lesson # 1** Summary:

- **Lesson #2** Summary:

- **Lesson #3** Summary:

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OBJECTIVES for LESSON # _____

- **Materials/Resources:**

- **Procedures:**

  - **Lead –in**

  - **Step by step**

  - **Closure**

- **Instructional strategies:** see curriculum introduction

- **Assessments:** see curriculum introduction
  - **Formative**

  - **Summative**