High School Accelerated Trigonometry Curriculum

Course Description: A pre-Calculus course for the college bound student. The term includes a strong emphasis on circular and triangular trigonometric functions, graphs of trigonometric functions and identities and trigonometric equations, polar coordinates, and vectors. This course is primarily taught through lectures, small group activities, and projects dealing with real-life situations. *Graphing calculators are required. See instructor for recommendations.

Scope and Sequence:

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<th>Timeframe</th>
<th>Unit</th>
<th>Instructional Topics</th>
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<td>Defining Trigonometric Functions and Angles</td>
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<td>Topic 2: Foundations</td>
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<td>Topic 3: Trigonometric Functions</td>
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<td>7 class periods</td>
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<td>Radian Measure</td>
<td>Topic 1: Radians</td>
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<td>Topic 1: Apply Fundamental Trigonometric Identities</td>
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<td></td>
<td>Topic 2: Use Identities to Evaluate Trigonometric Expressions</td>
</tr>
</tbody>
</table>
| 10 class periods | Inverse Trigonometric Functions and Solving Equations | Topic 1: Inverse Trigonometric Functions  
Topic 2: Solve Trigonometric Equations |
|------------------|------------------------------------------------------|---------------------------------------------------------------------------------|
| 8 class periods  | Solving Triangles | Topic 1: Law of Sines and Cosines  
Topic 2: Area |
| 9 class periods  | Vectors | Topic 1: Define Vectors  
Topic 2: Vector Operations  
Topic 3: Applications |
| 8 class periods  | Polar Plane | Topic 1: Convert to Polar  
Topic 2: Graph in the Polar Plane  
Topic 3: Complex Numbers |
Subject: Accelerated Trigonometry
Grade: 10, 11, 12
Name of Unit: Defining Trigonometric Functions and Angles
Length of Unit: 6 class periods
Overview of Unit: In this unit the student will learn the definitions of the trigonometric functions for angles in standard position on the rectangular plane. The student will review relationship between angles and different ways to express the measurement of an angle.

Priority Standards for unit:
- CBIMVI.2.1.1 Develops and applies the definition of the sine and cosine functions of the degree measure of a general angle in standard position in relation to the values of the y- and x-coordinates, respectively, of points on the terminal side of the angle.

Supporting Standards for unit:
- MOGeo.SRT.A.2: Use the definition of similarity to decide if figures are similar and to solve problems involving similar figures.
- IMIV.2.1.1 Forms conjectures based on exploring geometric situations with or without technology.
- ISTE-EMPOWERED LEARNER1.C - use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Unwrapped Concepts
(Students need to know)
- the definition of the sine and cosine functions of the degree measure of a general angle in standard position in relation to the values of the y- and x-coordinates, respectively, of points on the terminal side of the angle.

Unwrapped Skills
(Students need to be able to do)
- Develops

Bloom’s Taxonomy Levels
- Understand
- Webb's DOK
- 2

Essential Questions:
1. How do you express angles in different forms?
2. How do you use geometric foundations to find unknown angles?
3. How are trigonometric functions defined and evaluated?
Enduring Understanding/Big Ideas:
1. Angles can be converted between decimal degrees and DMS. An infinite number of coterminal angles can found for any angle in standard position.
2. The properties of parallel lines, triangles and similar triangles can be used to find unknown angles.
3. Trigonometric functions can be defined in the standard x-y coordinate plane. Given a quadrantal angle, or a point on the terminal side of the angle, one can find the value of all six trigonometric functions. This includes recognizing when a trigonometric function is positive or negative.

Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angles</td>
<td></td>
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<tr>
<td>Standard Position</td>
<td></td>
</tr>
<tr>
<td>Coterminal</td>
<td></td>
</tr>
<tr>
<td>Sine</td>
<td></td>
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<tr>
<td>Cosine</td>
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<td>Tangent</td>
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<td>Cosecant</td>
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<td>Secant</td>
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<tr>
<td>Cotangent</td>
<td></td>
</tr>
<tr>
<td>Supplementary</td>
<td></td>
</tr>
<tr>
<td>Complementary</td>
<td></td>
</tr>
<tr>
<td>Degrees-Minutes-Seconds</td>
<td></td>
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<tr>
<td>Quadrantal Angles</td>
<td></td>
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</tbody>
</table>

Resources for Vocabulary Development: Textbook
Engaging Experience 1
Title: White Board Activity - Angles
Suggested Length of Time: 25 minutes
Standards Addressed
   Supporting:
      ● IMIV.2.1.1 Forms conjectures based on exploring geometric situations with or without technology.
Detailed Description/Instructions: Teacher will provide a series of problems. Students will work out the problem on individual whiteboards and display so teacher can check for understanding. Questions should cover converting angles and relationships between angles.
Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Engaging Experience 1
Title: Kahoot! Warm Up Activity
Suggested Length of Time: 15 minutes

Standards Addressed
Supporting:
- MOGeo.SRT.A.2: Use the definition of similarity to decide if figures are similar and to solve problems involving similar figures.
- ISTE-EMPOWERED LEARNER1.C - use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

Detailed Description/Instructions: Students will compete in a game of Kahoot! where the questions cover review topics from geometry, including similar triangles, properties of triangles and properties of parallel lines.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Engaging Experience 1
Title: Question Creation
Suggested Length of Time: 30 minutes
Standards Addressed

Priority:

- CBIMVI.2.1.1 Develops and applies the definition of the sine and cosine functions of the degree measure of a general angle in standard position* in relation to the values of the y- and x-coordinates, respectively, of points on the terminal side of the angle.

Supporting:

- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Detailed Description/Instructions: Students will work in small groups to write questions regarding evaluating trigonometric functions in the coordinate plane. Groups will trade their created questions and then find solutions. Groups will discuss solutions with one another.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
**Engaging Scenario** (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.)

The students will be assigned the task of creating a unit test and an answer key. The questions should be original and not copied from the textbook. The test should be structured in the following way: Angles: 5 questions

Foundations: 5 questions

Trig Functions: 5 questions

Students will bring their test to class and trade with another student. They will check each other's work using the answer keys they create.

**Rubric for Engaging Scenario:** To be created
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angles</td>
<td>White Board Activity – Angles</td>
<td>Teacher will provide a series of problems. Students will work out the problem on individual whiteboards and display so teacher can check for understanding. Questions should cover converting angles and relationships between angles.</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Foundations</td>
<td>Kahoot! Warm Up Activity</td>
<td>Students will compete in a game of Kahoot! where the questions cover review topics from geometry, including similar triangles, properties of triangles and properties of parallel lines.</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Trigonometric</td>
<td>Question Creation</td>
<td>Students will work in small groups to write questions regarding evaluating trigonometric functions in the coordinate plane. Groups will trade their created questions and then find solutions. Groups will discuss solutions with one another.</td>
<td>30 minutes</td>
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</tbody>
</table>
Unit 2: Applying Trigonometric Functions

Subject: Accelerated Trigonometry
Grade: 10, 11, 12
Name of Unit: Applying Trigonometric Functions
Length of Unit: 7 class periods
Overview of Unit: Students will take an in depth look at the definitions of the six trigonometric functions and how they are evaluated in the standard coordinate plane. Students will evaluate the functions for all special angles and use reference angles to evaluate additional angles. Students will use their calculator to approximate values of trigonometric functions and use these approximations to solve right triangles in real-world scenarios.

Priority Standards for unit:
- IMV.4.1.4 Applies the sine, cosine, and tangent trigonometric ratios to determine lengths and angle measures in right triangles.
- IMV.4.1.3 Develops and applies the properties of 30°-60°-90° and 45°-45°-90° triangles; develops and applies proportional relationships involving the altitude drawn to the hypotenuse of a right triangle.

Supporting Standards for unit:
- IMV.4.1.5 Applies, singly and in combination, the Pythagorean theorem, properties of proportionality, trigonometric ratios, and similarity in solving mathematical and real-world problems.
- ISTE-COMPUTATIONAL THINKER.5.C - break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom's Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>the sine, cosine, and tangent trigonometric ratios to determine lengths and angle measures in right triangles.</td>
<td>Applies</td>
<td>Apply</td>
<td>2</td>
</tr>
<tr>
<td>the properties of 30°-60°-90° and 45°-45°-90° triangles; develops and applies proportional relationships involving the altitude drawn to the hypotenuse of a right triangle.</td>
<td>Develops</td>
<td>Understand</td>
<td>2</td>
</tr>
</tbody>
</table>
the properties of 30°-60°-90° and 45°-45°-90° triangles; develops and applies proportional relationships involving the altitude drawn to the hypotenuse of a right triangle.

<table>
<thead>
<tr>
<th>Essential Questions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How do you express trigonometric functions in terms of their cofunctions?</td>
</tr>
<tr>
<td>2. How do you evaluate trigonometric functions with angles in degree mode?</td>
</tr>
<tr>
<td>3. How do you use trigonometric functions to solve real-world problems?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enduring Understanding/Big Ideas:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All six trigonometric functions can be expressed in terms of their cofunction using their cofunction identities. Cofunction identities can also be used to solve for a missing variable in simple trigonometric equations.</td>
</tr>
<tr>
<td>2. With angles in degree mode, trigonometric functions can be evaluated using their definitions, special right triangles and reference angles. A calculator can be used to approximate values of trigonometric functions. One can also work backwards from a ratio to find an unknown angle in a simple trigonometric equation.</td>
</tr>
<tr>
<td>3. Trigonometric functions can be used to solve right triangles. This can be done from a theoretical lens or in context to many real-world scenarios, including: shadows, angle of elevation, angle of depression, bearing and navigation.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit Vocabulary:</th>
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<tbody>
<tr>
<td>Academic Cross-Curricular Words</td>
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<tr>
<td>Sine</td>
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<tr>
<td>Cosine</td>
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<tr>
<td>Tangent</td>
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<tr>
<td>Cosecant</td>
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<tr>
<td>Secant</td>
</tr>
<tr>
<td>Cotangent</td>
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<tr>
<td>Angle of Elevation</td>
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<td>Angle of Depression</td>
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<tr>
<td>Bearing</td>
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<tr>
<td>Heading</td>
</tr>
<tr>
<td>Reference Angle</td>
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<tr>
<td>Cofunction</td>
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</tbody>
</table>

Resources for Vocabulary Development: textbook
Engaging Experience 1
Title: Exploration of Trig Functions of Complementary Angles
Suggested Length of Time: 15 minutes

Standards Addressed

Priority:
- IMV.4.1.4 Applies the sine, cosine, and tangent trigonometric ratios to determine lengths and angle measures in right triangles.

Supporting:
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Detailed Description/Instructions: Teacher will provide guiding questions that lead students to make a conjecture about complementary angles and cofunctions. Students will work in small groups to develop their ideas. For example, students will compare the values of sin 60°, cos 60°, tan 60°, sin 30°, cos 30°, tan 30° and look for patterns.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Engaging Experience 1
Title: Whiteboard Activity Evaluating Trig Functions
Suggested Length of Time: 25 minutes
Standards Addressed
   Priority:
   - IMV.4.1.4 Applies the sine, cosine, and tangent trigonometric ratios to determine lengths and angle measures in right triangles.
   - IMV.4.1.3 Develops and applies the properties of 30°-60°-90° and 45°-45°-90° triangles; develops and applies proportional relationships involving the altitude drawn to the hypotenuse of a right triangle.

Detailed Description/Instructions: Teacher will provide questions in which students will evaluate the six trigonometric functions. Angles are in degree mode and will include angles in all four quadrants.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Topic 3: Applications of Trigonometric Functions

Engaging Experience 1
Title: Small Group Activity
Suggested Length of Time: 1/2 class period

Standards Addressed

Priority:
- IMV.4.1.4 Applies the sine, cosine, and tangent trigonometric ratios to determine lengths and angle measures in right triangles.

Supporting:
- IMV.4.1.5 Applies, singly and in combination, the Pythagorean theorem, properties of proportionality, trigonometric ratios, and similarity in solving mathematical and real-world problems.
- ISTE-COMPUTATIONAL THINKER.5.C - break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Detailed Description/Instructions: Teacher will provide students with a problem set in which they apply trigonometric functions to real-world situations. Examples of real-world situation would include shadow, navigation, and angles of depression and elevation. Solutions will also be provided in order for students to check their work and ask questions.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Engaging Scenario

Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.)

Students will write a 1-2-page paper that explains and summarizes the topics that thread throughout the chapter. The following topics should be covered in the paper:

- Deriving Special Right Triangles from a square and equilateral triangle
- Evaluating trig functions in quadrant I
- Evaluating trig functions of the quadrantal angles
- Using reflections to evaluate trig functions in all four quadrants

Students should focus on the connections between these topics as they write their paper.

Rubric for Engaging Scenario: to be created
## Summary of Engaging Learning Experiences for Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cofunctions</td>
<td>Exploration of Trig Functions of Complementary Angles</td>
<td>Teacher will provide guiding questions that lead students to make a conjecture about complementary angles and cofunctions. Students will work in small groups to develop their ideas. For example, students will compare the values of ( \sin 60^\circ ), ( \cos 60^\circ ), ( \tan 60^\circ ), ( \sin 30^\circ ), ( \cos 30^\circ ), ( \tan 30^\circ ) and look for patterns.</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Evaluate Trigonometric Functions</td>
<td>Whiteboard Activity Evaluating Trig Functions</td>
<td>Teacher will provide questions in which students will evaluate the six trigonometric functions. Angles are in degree mode and will include angles in all four quadrants.</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Applications of Trigonometric Functions</td>
<td>Small Group Activity</td>
<td>Teacher will provide students with a problem set in which they apply trigonometric functions to real-world situations. Examples of real-world situation would include shadow, navigation, and angles of depression and elevation. Solutions will also be provided in order for students to check their work and ask questions.</td>
<td>( \frac{1}{2} ) class period</td>
</tr>
</tbody>
</table>
Unit 3: Radian Measure

**Subject:** Accelerated Trigonometry  
**Grade:** 10, 11, 12  
**Name of Unit:** Radian Measure  
**Length of Unit:** 8 class periods

**Overview of Unit:** This unit will introduce students to radian measure and the Unit Circle. Students will be comfortable converting angles between radian and degree mode, along with evaluating trigonometric functions given radian measure. Students will also learn how to find the arc length and area of a sector. They unit will also introduce the relationship between linear and angular speed through real-world applications.

**Priority Standards for unit:**
- CBIMVI.2.1.3 Defines the trigonometric functions as functions of the radian measure of a general angle, and describes them as functions of real numbers.
- CBIMVI.2.1.2 Develops radian measure of angles, measures angles in both degrees and radians, and converts between these measures.

**Supporting Standards for unit:**
- CBIMVI.2.1.4 Develops and applies the values of the trigonometric functions at 0, π/6, π/4, π/3, π/2 radians and their multiples.
- MOGeo.C.B.1: Derive the formula for the length of an arc of a circle.
- MOGeo.C.B.2: Derive the formula for the area of a sector of a circle.
- ISTE-DIGITAL CITIZEN.2.B - engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defines the trigonometric functions as functions of the radian measure of a general angle, and describes them as functions of real numbers.</td>
<td>Defines</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>Defines the trigonometric functions as functions of the radian measure of a general angle, and _____ them as functions of real numbers.</td>
<td>describes</td>
<td>Understand</td>
<td>3</td>
</tr>
</tbody>
</table>
_____ radian measure of angles, measures angles in both degrees and radians, and converts between these measures. | Develops | Understand | 2

**Essential Questions:**
1. How are radians similar and how are they different from degrees.
2. How can trigonometric functions be applied to angles given in terms of radians?
3. Why are radians sometimes preferred over degrees?

**Enduring Understanding/Big Ideas:**
1. Radians and degrees are both used to measures angles and can be converted from one form to the other. However, a radian is different from a degree in that it is defined as a length on the unit circle and can be used as simply a number.
2. The unit circle can be used to define trigonometric functions which allows them to be extended to radians and numbers. Given the value of a trig function it is then possible to find the set of angles in radians or degrees that would give that value.
3. The formulas for the area of a sector or the length of an arc of a circle are more simple in radian form. It results in applications to linear and angular velocities being easier in radians.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Speed</td>
<td>Sine</td>
</tr>
<tr>
<td>Angular Speed</td>
<td>Cosine</td>
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<td></td>
<td>Tangent</td>
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<td></td>
<td>Cosecant</td>
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<td>Secant</td>
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<td></td>
<td>Cotangent</td>
</tr>
<tr>
<td></td>
<td>Radians</td>
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<tr>
<td></td>
<td>Unit Circle</td>
</tr>
<tr>
<td></td>
<td>Sector</td>
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<td></td>
<td>Arc Length</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Engaging Experience 1

Title: Rad War

Suggested Length of Time: 15 minutes

Standards Addressed

Priority:

- CBIMVI.2.1.2 Develops radian measure of angles, measures angles in both degrees and radians, and converts between these measures.

Detailed Description/Instructions: Teacher will provide students with a deck of cards containing a degree measure on one side of the card and a radian measure on the other side of the card. The students will partner up with a deck of cards, revealing an angle measure. The students will race to convert the angle to the other mode. The winner takes the card.

Bloom’s Levels: Understand

Webb’s DOK: 2

Rubric: N/A
Topic 2: Trigonometric Functions

Engaging Experience 1
Title: Whiteboards in Small Groups
Suggested Length of Time: 25 minutes

Standards Addressed

Priority:
- CBIMVI.2.1.3 Defines the trigonometric functions as functions of the radian measure of a general angle, and describes them as functions of real numbers.

Supporting:
- CBIMVI.2.1.4 Develops and applies the values of the trigonometric functions at 0, π/6, π/ 4, π/3, π/2 radians and their multiples.
- ISTE - GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Detailed Description/Instructions: Teacher will split class into 3 to 4 groups (5-10 students in each group). One student will create a problem for the group to complete on their whiteboards. The problem should be one where they are evaluating trigonometric functions using special angles in radian mode. The first student to answer correctly then comes up with the next problem for the group. Students should use all six trigonometric functions along with angles from each quadrant. Questions should be discussed within the groups as they arise.

Bloom’s Levels: Understand
Webb’s DOK: 2
Rubric: N/A
Engaging Experience 1
Title: Quizizz
Suggested Length of Time: 30 minutes
Standards Addressed
Supporting:

- MOGeo.C.B.1: Derive the formula for the length of an arc of a circle.
- MOGeo.C.B.2: Derive the formula for the area of a sector of a circle.
- ISTE-DIGITAL CITIZEN.2.B - engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.

Detailed Description/Instruction: Teacher will create a Quizizz game via quizizz.com. This is an interactive interface which allows students to work through questions. The students and teachers are able to see the results. The questions should cover sectors and speed.

Bloom’s Levels: Analyze
Webb’s DOK: 2
Rubric: N/A
Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.)

Design a carousel with two rows of horses. There must 5 feet between the two rows of horses and the maximum linear speed of any child on the carousel is 200 ft/min. Determine the rotation speed and the inner and outer radii of the rows of horses for your carousel (more than one carousel is possible). Present calculations supporting your design.

Rubric for Engaging Scenario: to be created
### Summary of Engaging Learning Experiences for Topics

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<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radians</td>
<td>Rad War</td>
<td>Teacher will provide students with a deck of cards containing a degree measure on one side of the card and a radian measure on the other side of the card. The students will partner up with a deck of cards, revealing an angle measure. The students will race to convert the angle to the other mode. The winner takes the card.</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Trigonometric Functions</td>
<td>Whiteboards in Small Groups</td>
<td>Teacher will split class into 3 to 4 groups (5-10 students in each group). One student will create a problem for the group to complete on their whiteboards. The problem should be one where they are evaluating trigonometric functions using special angles in radian mode. The first student to answer correctly then comes up with the next problem for the group. Students should use all six trigonometric functions along with angles from each quadrant. Questions should be discussed within the groups as they arise.</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Sectors and Speed</td>
<td>Quizizz</td>
<td>Teacher will create a Quizizz game via quizizz.com. This is an interactive interface which allows students to work through questions. The students and teachers are able to see the results. The questions should cover sectors and speed.</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>
Unit 4: Graphing Trigonometric Functions

Subject: Accelerated Trigonometry  
Grade: 10, 11, 12  
Name of Unit: Graphing Trigonometric Functions  
Length of Unit: 12 class periods

Overview of Unit: This unit introduces the graphs of the six trigonometric functions. Students will graph the functions and apply transformations to the graphs. Students will be able to state the properties of the functions from both the equations and graphs. The students will write equations to model curves, including real-world applications.

Priority Standards for unit:
- CBIMVI.2.1.5 Constructs the graphs of the trigonometric functions, and describes their behavior, including periodicity, amplitude, zeros, and symmetries.
- MOPA2.2: Use parameter changes to amplitude, period, midline and phase shift to model real-world contexts. Use the form \( f(t) = A \sin(B(t+h)) + k \) and explain how to determine each of the parameters A, B, h and k.

Supporting Standards for unit:
- CBIMVI.1.1.1 Determines the domain and range of functions as represented by symbols and graphs, where appropriate.
- CBIMVI.2.2.4 Uses trigonometric functions to model and solve problems in mathematics and other disciplines.
- MOPA2.1: Using a unit circle, create the functions \( f(t) = \sin(t) \) and \( g(t) = \cos(t) \) to define the position of a point on the circle, at time t. Graph these functions in the Cartesian coordinate plane, and define and explore amplitude, period and midline.
- ISTE-KNOWLEDGE COLLECTOR.3.A - plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
- ISTE-COMPUTATIONAL THINKER.5.B - collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>the graphs of the trigonometric functions, and describes their behavior, including periodicity, amplitude, zeros, and symmetries.</td>
<td>Constructs</td>
<td>Apply</td>
<td>2</td>
</tr>
</tbody>
</table>
Constructs the graphs of the trigonometric functions, and _____ their behavior, including periodicity, amplitude, zeros, and symmetries. | Describes | Analyze | 3
---|---|---|---
_____ parameter changes to amplitude, period, midline and phase shift to model real-world contexts. _____ the form \( f(t) = A \sin(B(t+h)) + k \) and explain how to determine each of the parameters A, B, h and k. | Use | Apply | 3
Use parameter changes to amplitude, period, midline and phase shift to model real-world contexts. Use the form \( f(t) = A \sin(B(t+h)) + k \) and _____ how to determine each of the parameters A, B, h and k. | Explain | Analyze | 3

**Essential Questions:**
1. How do you graph and apply transformations to the six trigonometric functions?
2. How can trigonometric functions be used to model real-world phenomena?

**Enduring Understanding/Big Ideas:**
1. The six trigonometric functions can be graphed over multiple periods. The period, amplitude, domain and range can be stated for every function. The graphs can be transformed through changes in amplitude, period, phase shifts, vertical shifts and reflections. The properties of the transformed graphs should also be stated using proper notation.
2. Sinusoidal curves can be used to model phenomena including springs, the rise and fall of tides and weather patterns. Given a sinusoidal curve, an equation can be written in terms of sine and cosine.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>Sine</td>
</tr>
<tr>
<td>Amplitude</td>
<td>Cosine</td>
</tr>
<tr>
<td></td>
<td>Tangent</td>
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<td></td>
<td>Cosecant</td>
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<td></td>
<td>Secant</td>
</tr>
<tr>
<td></td>
<td>Cotangent</td>
</tr>
<tr>
<td></td>
<td>Domain</td>
</tr>
<tr>
<td>Range Transformations</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td></td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Engaging Experience 1
Title: Research Project
Suggested Length of Time: 1 class period

Standards Addressed

Priority:
- CBIMVI.2.1.5 Constructs the graphs of the trigonometric functions, and describes their behavior, including periodicity, amplitude, zeros, and symmetries.

Supporting:
- ISTE-KNOWLEDGE COLLECTOR.3.A - plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

Detailed Description/Instructions: The teacher will provide a packet of questions for students to research on their own. The questions cover the graphs of the six trigonometric functions and also the properties of the parent functions. Students will use textbook and the internet to do the research. Resource located in Schoology.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Engaging Experience 1
Title: Weather Patterns
Suggested Length of Time: 30 minutes

Standards Addressed

Priority:
- MOPA2.2: Use parameter changes to amplitude, period, midline and phase shift to model real-world contexts. Use the form \( f(t) = A \sin(B(t+h)) + k \) and explain how to determine each of the parameters \( A, B, h \) and \( k \).

Supporting:
- CBIMVI.2.2.4 Uses trigonometric functions to model and solve problems in mathematics and other disciplines.
- ISTE-KNOWLEDGE COLLECTOR.3.A - plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
- ISTE-COMPUTATIONAL THINKER.5.B - collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Detailed Description/Instructions: Each student will partner up with another student. The students will choose a destination, anywhere in the world, to travel. The students will research the average monthly temperatures for the destination and write a sinusoidal equation to model the temperatures. Using their equation, they will determine the expected temperature on their travel dates and summarize their findings. Resource located in Schoology.

Bloom’s Levels: Apply
Webb’s DOK: 3
Rubric: N/A
Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.)

Sinusoidal curves occur in many different places in the real world. Students will research this and choose a real-world phenomenon that can be modeled with sinusoidal curves. The student will take an in-depth look at this topic. They will collect data points from their specific example and use those to write sinusoidal equations. The students will present their findings to the class. This could be short in-class presentations or short videos the students create.

Rubric for Engaging Scenario: to be created
## Summary of Engaging Learning Experiences for Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graph Trigonometric Functions</td>
<td>Research Project</td>
<td>The teacher will provide a packet of questions for students to research on their own. The questions cover the graphs of the six trigonometric functions and also the properties of the parent functions. Students will use textbook and the internet to do the research. Resource located in Schoology.</td>
<td>1 class period</td>
</tr>
<tr>
<td>Model</td>
<td>Weather Patterns</td>
<td>Each student will partner up with another student. The students will choose a destination, anywhere in the world, to travel. The students will research the average monthly temperatures for the destination and write a sinusoidal equation to model the temperatures. Using their equation, they will determine the expected temperature on their travel dates and summarize their findings. Resource located in Schoology.</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>
Unit 5: Trigonometric Identities

Subject: Accelerated Trigonometry
Grade: 10, 11, 12
Name of Unit: Trigonometric Identities
Length of Unit: 12 class periods
Overview of Unit: Students will build on their knowledge of trigonometric identities to develop fundamental, sum and difference, and double- and half-angle identities. They will apply these identities to simplify trigonometric expressions and verify given trigonometric identities. Students will also apply these to evaluate trigonometric expressions given known and unknown angles.

Priority Standards for unit:
- MOPA2.4: Solve problems using trigonometric identities.

Supporting Standards for unit:
- CBIMVI.2.1.7 Develops the fundamental Pythagorean trigonometric identities, sum and difference identities, double-angle identities, and the secant, cosecant, and cotangent functions, and uses them to simplify trigonometric expressions.
- ISTE-EMPOWERED LEARNER1.C - use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____ problems using trigonometric identities.</td>
<td>Solve</td>
<td>Evaluate</td>
<td>4</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How can the fundamental identities be used to simplify expressions and verify other trigonometric identities?
2. How can the trigonometric values of given angles be used to generate the trigonometric values of other angles?

Enduring Understanding/Big Ideas:
1. The fundamental identities allow functions to be written in terms of other functions. Then algebraic methods can be applied to simplify expressions or to match it with another expression.
2. Given the trig values for a pair of angles, identities can be used to find the trig values of the sum or difference of the given angles. Given the trig values for an angle, identities can be used to find the trig values for twice and half the angle.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify</td>
<td>Sine</td>
</tr>
<tr>
<td></td>
<td>Cosine</td>
</tr>
<tr>
<td></td>
<td>Tangent</td>
</tr>
<tr>
<td></td>
<td>Cosecant</td>
</tr>
<tr>
<td></td>
<td>Secant</td>
</tr>
<tr>
<td></td>
<td>Cotangent</td>
</tr>
<tr>
<td></td>
<td>Fundamental Identities</td>
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<tr>
<td></td>
<td>Reciprocal Identities</td>
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<tr>
<td></td>
<td>Quotient Identities</td>
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<tr>
<td></td>
<td>Pythagorean Identities</td>
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<tr>
<td></td>
<td>Sum and Difference Identities</td>
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<tr>
<td></td>
<td>Double-Angle Identities</td>
</tr>
<tr>
<td></td>
<td>Half-Angle Identities</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Engaging Experience 1
Title: Tutorial Groups
Suggested Length of Time: 45 minutes
Standards Addressed
Priority:
- MOPA2.4: Solve problems using trigonometric identities.

Detailed Description/Instructions: Students will fill out a Tutorial Request Form (TRF) where they choose a problem where they are asked to verify a trigonometric identity. The students will take turns presenting their problems to their group (3-5 students) on a whiteboard. The students will work together to solve the problem by using questioning and discussion. After each problem, the students will summarize their work.

Bloom’s Levels: Evaluate
Webb’s DOK: 4
Rubric: N/A
Engaging Experience 1

Title: Formative Online Activity

Suggested Length of Time: 30 minutes

Standards Addressed

Priority:
- MOPA2.4: Solve problems using trigonometric identities.

Supporting:
- ISTE-EMPOWERED LEARNER1.C - use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

Detailed Description/Instructions: Teacher will create a lesson on goformative.com. This website allows students to work out problems on a computer, giving the teacher live results. Students show their work on their screens, giving the teacher the ability to check for understanding across multiple screens. Questions should cover sum, difference, double and half angle identities, both finding exact values and questions in the coordinate plane.

Bloom’s Levels: Evaluate
Webb’s DOK: 4
Rubric: N/A
**Engaging Scenario**

(An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.)

During the last day of the unit, students will complete Tutorials in small groups (4-6 students). Each student will complete a tutorial request form (TRF) in preparation for the activity. See Schoology for TRF. Students will take turns presenting their questions, with their points of confusion to their group. The groups will use questioning to guide the students to the correct answer. After completing each question, the students will summarize, in writing, the steps taken to solve the problem at hand. After class, the students will complete the back of the TRF on their own.

**Rubric for Engaging Scenario:** To be created
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply Fundamental Trigonometric Identities</td>
<td>Tutorial Groups <img src="image.png" alt="groups" /></td>
<td>Students will fill out a Tutorial Request Form (TRF) where they choose a problem where they are asked to verify a trigonometric identity. The students will take turns presenting their problems to their group (3-5 students) on a whiteboard. The students will work together to solve the problem by using questioning and discussion. After each problem, the students will summarize their work.</td>
<td>45 minutes</td>
</tr>
<tr>
<td>Use Identities to Evaluate Trigonometric Expressions</td>
<td>Formative Online Activity <img src="image.png" alt="activity" /></td>
<td>Teacher will create a lesson on goformative.com. This website allows students to work out problems on a computer, giving the teacher live results. Students show their work on their screens, giving the teacher the ability to check for understanding across multiple screens. Questions should cover sum, difference, double and half angle identities, both finding exact values and questions in the coordinate plane.</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>
Unit 6: Inverse Trigonometric Functions and Solving Equations

Subject: Accelerated Trigonometry
Grade: 10, 11, 12
Name of Unit: Inverse Trigonometric Functions and Solving Equations
Length of Unit: 10 class periods
Overview of Unit: In this unit the student will evaluate inverse trigonometric functions. They will identify the domain and range of the inverse functions. Students will also solve various forms of trigonometric equations. The students will use trigonometric identities and inverse trigonometric functions to solve equations.

Priority Standards for unit:
- MOPA2.3: Solve equations involving trigonometric functions.

Supporting Standards for unit:
- CBIMVI.2.1.6 Defines and graphs inverses of trigonometric functions with appropriately restricted domains.
- CBIMVI.2.2.3 Solves trigonometric equations, noting the periodic nature of solutions when applicable, and interprets the solutions graphically.
- ISTE-EMPOWERED LEARNER1.C - use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
- ISTE-DIGITAL CITIZEN.2.B - engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.
- ISTE-CREATIVE COMMUNICATOR.6.A - choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
- ISTE-CREATIVE COMMUNICATOR.6.B - create original works or responsibly repurpose or remix digital resources into new creations.
- ISTE-CREATIVE COMMUNICATOR.6.C - communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
- ISTE-CREATIVE COMMUNICATOR.6.D - publish or present content that customizes the message and medium for their intended audiences.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.
Unwrapped Concepts (Students need to know) | Unwrapped Skills (Students need to be able to do) | Bloom’s Taxonomy Levels | Webb's DOK
--- | --- | --- | ---
equations involving trigonometric functions. | Solve | Apply | 4

**Essential Questions:**
1. How do you evaluate inverse trigonometric functions?
2. How do you find solutions to a variety of trigonometric equations?

**Enduring Understanding/Big Ideas:**
1. Inverse trigonometric functions can be evaluated using knowledge of special angles and the range rules of inverse trigonometric functions. A calculator can be used to approximate values of inverse trigonometric functions. One should be able to recognize the graphs of the inverse trigonometric functions and pair these graphs with their respective functions.
2. A variety of trigonometric equations can be solved over a given interval with and without a calculator. These include equations in the following forms: linear, quadratic, rational, absolute value, double angle, and half angle. One can also use known trigonometric identities to solve equations. Solutions can be expressed in both degree and radian mode.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval</td>
<td>Sine</td>
</tr>
<tr>
<td></td>
<td>Cosine</td>
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<td></td>
<td>Tangent</td>
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<td></td>
<td>Cosecant</td>
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<td></td>
<td>Secant</td>
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<td></td>
<td>Cotangent</td>
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<tr>
<td></td>
<td>Inverse function</td>
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<tr>
<td></td>
<td>Range</td>
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<td></td>
<td>Reference angle</td>
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<tr>
<td></td>
<td>Coterminal</td>
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</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Engaging Experience 1
Title: Kahoot! Activity
Suggested Length of Time: 20 minutes
Standards Addressed

Supporting:
- CBIMVI.2.1.6 Defines and graphs inverses of trigonometric functions with appropriately restricted domains.
- ISTE-EMPOWERED LEARNER1.C - use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

Detailed Description/Instructions: Teacher will create a quiz on kahoot.com, an interactive online quiz game. The quiz will cover finding exact value of inverse trigonometric functions. The class will complete the quiz as a class, going over points of confusion as they arise.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Topic 2: Solve Trigonometric Equations

Engaging Experience 1
Title: Tutorial Groups
Suggested Length of Time: 45 minutes

Standards Addressed

Priority:

- MOPA2.3: Solve equations involving trigonometric functions.

Supporting:

- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Detailed Description/Instructions: Students will fill out a Tutorial Request Form (TRF) where they choose a problem where they are asked to solve a trigonometric equation. The students will take turns presenting their problems to their group (3-5 students) on a whiteboard. The students will work together to solve the problem by using questioning and discussion. After each problem, the students will summarize their work.

Bloom’s Levels: Apply

Webb’s DOK: 4

Rubric: N/A
Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.) Students will create a video or record a screencast where they solve two trigonometric equations and explain their thinking. One equation should be able to be solved without a calculator and the other should be one where a calculator needs to be used. The equations can be original or borrowed from an outside resource. The students should explain their work and thinking thoroughly, including algebraic reasoning, use of inverse trig functions and justifying the quadrants in which solutions are found.

Rubric for Engaging Scenario: To be created
## Summary of Engaging Learning Experiences for Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverse Trigonometric Functions</td>
<td>Kahoot! Activity</td>
<td>Teacher will create a quiz on kahoot.com, an interactive online quiz game. The quiz will cover finding exact value of inverse trigonometric functions. The class will complete the quiz as a class, going over points of confusion as they arise.</td>
<td>20 minutes</td>
</tr>
<tr>
<td>Solve Trigonometric Equations</td>
<td>Tutorial Groups (TRF)</td>
<td>Students will fill out a Tutorial Request Form (TRF) where they choose a problem where they are asked to solve a trigonometric equation. The students will take turns presenting their problems to their group (3-5 students) on a whiteboard. The students will work together to solve the problem by using questioning and discussion. After each problem, the students will summarize their work.</td>
<td>45 minutes</td>
</tr>
</tbody>
</table>
Unit 7: Solving Triangles

Subject: Accelerated Trigonometry
Grade: 10, 11, 12
Name of Unit: Solving Triangles
Length of Unit: 8 class periods

Overview of Unit: In this unit students will solve triangles using Law of Sines and Cosines, including the ambiguous class of the Law of Sines. Students will apply the Law of Sines and Cosines to real world problems such as navigation. Students will also find areas of triangles when the height is unknown.

Priority Standards for unit:

Supporting Standards for unit:
- MOGeo.SRT.C.4: Derive the formula $A = \frac{1}{2} ab \sin(C)$ for the area of a triangle.
- CBIMVI.2.2.4 Uses trigonometric functions to model and solve problems in mathematics and other disciplines.
- ISTE-COMPUTATIONAL THINKER.5.C - break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb’s DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>problems using Law of Sines and Law of Cosines.</td>
<td>Solve</td>
<td>Apply</td>
<td>4</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How do you find missing angles and side lengths to all types of triangles?
2. How do you find area of triangles and quadrilaterals?

Enduring Understanding/Big Ideas:
1. Triangles can be solved using a variety of methods. Right triangles can be solved using the definitions of the trigonometric functions. The Law of Sines and the Law of Cosines can be used to solve all types of triangles. One is able to recognize when one, two or no triangles exists to fit a given situation. These skills can be applied to real-world situations, including bearing and angle of elevation and depression.
2. The area of a triangle can be found using the formula, \( A = \frac{1}{2}ab \sin \theta \) and also Heron’s Formula. The area of a quadrilateral can be found by considering the diagonal that splits the quadrilateral into two triangles.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambiguous</td>
<td>Sine</td>
</tr>
<tr>
<td></td>
<td>Cosine</td>
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<tr>
<td></td>
<td>Tangent</td>
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<td></td>
<td>Cosecant</td>
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<td></td>
<td>Secant</td>
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<tr>
<td></td>
<td>Cotangent</td>
</tr>
<tr>
<td></td>
<td>Law of Sines</td>
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<tr>
<td></td>
<td>Law of Cosines</td>
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<tr>
<td></td>
<td>Area</td>
</tr>
<tr>
<td></td>
<td>Bearing</td>
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<tr>
<td></td>
<td>Heading</td>
</tr>
<tr>
<td></td>
<td>Angle of Elevation</td>
</tr>
<tr>
<td></td>
<td>Angle of Depression</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Engaging Experience 1
Title: Solving Triangles on the Whiteboard
Suggested Length of Time: ½ class period
Standards Addressed
Priority:

Detailed Description/Instructions: The students will solve a number of triangles using the Law of Sines and Law of Cosines on the white boards. The students will determine which law is needed to solve the triangles.

Bloom’s Levels: Apply
Webb’s DOK: 4
Rubric: N/A

Engaging Experience 2
Title: Ambiguous Case of Law of Sines
Suggested Length of Time: 30 minutes
Standards Addressed
Priority:
Supporting:
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Detailed Description/Instructions: Students will be placed in small groups. Each group will be given the length of two sides and an angle that form the ambiguous case. The group will then construct both triangles. They will then solve both of their triangles.

Bloom’s Levels: Apply
Webb’s DOK: 4
Rubric: N/A

Engaging Experience 3
Title: Applications of Law of Sines and Cosines
Suggested Length of Time: ½ class period
Standards Addressed
Priority:
Supporting:

- CBIMVI.2.2.4 Uses trigonometric functions to model and solve problems in mathematics and other disciplines.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

**Detailed Description/Instructions:** Students will work in groups of two. They will be given an application problem. They will draw the situation and then solve the problem. The groups of two will be joined to make groups of four. The group will then analyze both solutions.

**Bloom’s Levels:** Apply

**Webb’s DOK:** 4

**Rubric:** N/A
Engaging Experience 1
Title: Exploring the Area of Quadrilaterals
Suggested Length of Time: 30 minutes
Standards Addressed

Priority:

Supporting:
- MOGeo.SRT.C.4: Derive the formula $A = \frac{1}{2} ab \sin(C)$ for the area of a triangle.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.
- ISTE-COMPUTATIONAL THINKER.5.C - break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Detailed Description/Instructions: Teacher will provide students with a handout that allows them to explore the area of quadrilaterals. Students will work together in small groups to find all the possible ways to find the area of a rectangle. They will then have to apply these ideas to finding the area of irregular quadrilaterals. Teacher will provide guidance and assistance.

Bloom’s Levels: Apply
Webb’s DOK: 4
Rubric: N/A
Engaging Scenario

**Engaging Scenario** (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.)
The teacher will create a number of triangles and quadrilaterals with painter’s tape in the classroom. These will be taped out on the floor, whiteboards, etc. Each group of students will be given a protractor and ruler or yardstick and assigned a couple of shapes. They will then find the areas using two methods. They will present their findings and methods to the class.

**Rubric for Engaging Scenario:** to be created
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law of Sines and Cosines</td>
<td>Solving Triangles on the Whiteboard</td>
<td>The students will solve a number of triangles using the Law of Sines and Law of Cosines on the white boards. The students will determine which law is needed to solve the triangles.</td>
<td>½ class period</td>
</tr>
<tr>
<td>Law of Sines and Cosines</td>
<td>Ambiguous Case of Law of Sines</td>
<td>Students will be placed in small groups. Each group will be given the length of two sides and an angle that form the ambiguous case. The group will then construct both triangles. They will then solve both of their triangles.</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Law of Sines and Cosines</td>
<td>Applications of Law of Sines and Cosines</td>
<td>Students will work in groups of two. They will be given an application problem. They will draw the situation and then solve the problem. The groups of two will be joined to make groups of four. The group will then analyze both solutions.</td>
<td>½ class period</td>
</tr>
<tr>
<td>Area</td>
<td>Exploring the Area of Quadrilaterals</td>
<td>Teacher will provide students with a handout that allows them to explore the area of quadrilaterals. Students will work together in small groups to find all the possible ways to find the area of a rectangle. They will then have to apply these ideas to finding the area of irregular quadrilaterals. Teacher will provide guidance and assistance.</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>
Unit 8: Vectors

Subject: Accelerated Trigonometry
Grade: 10, 11, 12
Name of Unit: Vectors
Length of Unit: 9 class periods
Overview of Unit: In this unit the student will write vectors in magnitude, direction and displacement form. The student will perform vector operations and apply vectors to real world situations.

Priority Standards for unit:
- CBIMVI.4.1.1 Defines vectors in two dimensions as objects having magnitude and direction, and represents them geometrically.
- MOPA2.8: Perform operations with matrices and vectors.

Supporting Standards for unit:
- CBIMVI.4.1.2 Illustrates and applies the properties of vector addition and scalar multiplication to represent, investigate, and solve problems.
- CBIMVI.4.1.3 Uses vectors in modeling physical situations to solve problems.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.
- ISTE-COMPUTATIONAL THINKER.5.C - break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb’s DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____ vectors in two dimensions as objects having magnitude and direction, and represents them geometrically.</td>
<td>Defines</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>Defines vectors in two dimensions as objects having magnitude and direction, and _____ them geometrically.</td>
<td>Represents</td>
<td>Apply</td>
<td>2</td>
</tr>
<tr>
<td>_____ operations with matrices and vectors.</td>
<td>Perform</td>
<td>Apply</td>
<td>2</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How do you define vectors and perform vector operations?
2. How are vectors applied in the real world?
Enduring Understanding/Big Ideas:

1. Vectors can be defined using magnitude and direction or by using displacement. Operations performed on vectors include: addition, subtraction, scalar multiplication, dot product and cross product. One is also able to find the angle between two given vectors.
2. Vectors are used to model forces. They can be used solve problems involving the effect of wind or water currents in a given situation.

Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vector</td>
<td>Sine</td>
</tr>
<tr>
<td>Scalar</td>
<td>Cosine</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Tangent</td>
</tr>
<tr>
<td>Dot Product</td>
<td>Cross Product</td>
</tr>
</tbody>
</table>

Resources for Vocabulary Development: Textbook
Topic 1: Define Vectors

Engaging Experience 1
Title: Vectors in Geometric Form
Suggested Length of Time: 30 minutes

Standards Addressed

Priority:
- CBIMVI.4.1.1 Defines vectors in two dimensions as objects having magnitude and direction, and represents them geometrically.

Supporting:
- CBIMVI.4.1.2 Illustrates and applies the properties of vector addition and scalar multiplication to represent, investigate, and solve problems.

Detailed Description/Instructions: Students will be given vectors in graphical form. From the graph they will describe the vectors in magnitude, direction form and in displacement form. The students will add given vectors geometrically and describe the sum in displacement form.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Topic 2: Vector Operations

Engaging Experience 1
Title: Operations with Vectors on the Whiteboard
Suggested Length of Time: 30 minutes

Standards Addressed

Priority:
- MOPA2.8: Perform operations with matrices and vectors.

Supporting:
- CBIMVI.4.1.2 Illustrates and applies the properties of vector addition and scalar multiplication to represent, investigate, and solve problems.

Detailed Description/Instructions: Students will apply the rules of operations with vectors in a variety of problems on the whiteboards. Teacher will check for understanding.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Engaging Experience 1
Title: Applications of Vectors
Suggested Length of Time: 1 class period
Standards Addressed

Priority:

- MOPA2.8: Perform operations with matrices and vectors.

Supporting:

- CBIMVI.4.1.3 Uses vectors in modeling physical situations to solve problems.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Detailed Description/Instructions: Students will be placed in small groups. Each group will be given an application problem. The problems will include wind and water currents effect on direction traveled and multiple forces acting on an object. Each group will share their geometric representation and solution of their problem with the class.

Bloom’s Levels: Apply
Webb’s DOK: 3
Rubric: N/A
Engaging Scenario

Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.) This scenario is designed with parts that could be used as the student progresses through the unit.

Part 1: A boat is being pulled on a trailer at a speed of 45 mph on a straight road with a heading of N 50 degrees E to a river. If the river is 60 miles from the starting point, give the displacement vector of the boat’s path to the river.

Part 2: Two people are unloading the boat. They both have ropes attached to the boat at the same point. One person is pulling with a force 12 lb. and the other with a force 18 lbs. If the angle between the ropes is 30 degrees, find the resultant force on the boat and the angle of the path of the boat and the rope with a force of 12 lb.

Part 3: The boat has to be placed in the river which is 2 miles wide and flows due east. The people in the boat want to travel to a point directly across the river. If the current of the river is approximately 5 mph, find the course they should set.

Rubric for Engaging Scenario: to be created
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define Vectors</td>
<td>Vectors in Geometric Form</td>
<td>Students will be given vectors in graphical form. From the graph they will describe the vectors in magnitude, direction form and in displacement form. The students will add given vectors geometrically and describe the sum in displacement form.</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Vector Operations</td>
<td>Operations with Vectors on the Whiteboard</td>
<td>Students will apply the rules of operations with vectors in a variety of problems on the whiteboards. Teacher will check for understanding.</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Applications</td>
<td>Applications of Vectors</td>
<td>Students will be placed in small groups. Each group will be given an application problem. The problems will include wind and water currents effect on direction traveled and multiple forces acting on an object. Each group will share their geometric representation and solution of their problem with the class.</td>
<td>1 class period</td>
</tr>
</tbody>
</table>
Unit 9: Polar Plane

Subject: Accelerated Trigonometry
Grade: 10, 11, 12
Name of Unit: Polar Plane
Length of Unit: 8 class periods
Overview of Unit: In this unit the student will plot points and graph curves in the polar plane. Standard polar curves such as roses and limacons will be graphed with and without a graphing utility. The student will also write complex numbers in polar form and perform operations on the polar form.

Priority Standards for unit:
- CBIMVI.3.2.1 Expresses points in the plane in both rectangular and polar forms.
- MOPA2.6: Graph using polar coordinates.

Supporting Standards for unit:
- CBIMVI.2.2.2 Relates and uses rectangular and polar representations of complex numbers, and uses DeMoivre’s theorem.
- ISTE-CREATIVE COMMUNICATOR.6.A - choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
- ISTE-CREATIVE COMMUNICATOR.6.B - create original works or responsibly repurpose or remix digital resources into new creations.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>____ points in the plane in both rectangular and polar forms.</td>
<td>Expresses</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>____ using polar coordinates.</td>
<td>Graph</td>
<td>Apply</td>
<td>2</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How is the polar plane different from the rectangular plane?
2. Why is the polar plane used for some plane curves?
3. How can the polar plane be applied to complex numbers?

Enduring Understanding/Big Ideas:
1. In the polar plane points are plotted by distance from the pole(origin) and the angle of rotation measured from the polar axis (positive x-axis) instead of horizontal and vertical displacement from the origin. Trigonometry allows conversion between the two systems.
2. Curves, such as limacons, roses, lemniscates, have very simple polar equations and very complex rectangular equations. By learning basic forms of polar equations, the curves can be quickly sketched.

3. Using trigonometry, complex numbers in the a+bi form can be converted to polar form just like rectangular points can be converted to polar points. In polar form, the operations on complex numbers can be simplified and DeMoivre’s Theorem can be applied.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
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<tbody>
<tr>
<td></td>
<td>Sine</td>
</tr>
<tr>
<td></td>
<td>Cosine</td>
</tr>
<tr>
<td></td>
<td>Tangent</td>
</tr>
<tr>
<td></td>
<td>Cosecant</td>
</tr>
<tr>
<td></td>
<td>Secant</td>
</tr>
<tr>
<td></td>
<td>Cotangent</td>
</tr>
<tr>
<td></td>
<td>Polar</td>
</tr>
<tr>
<td></td>
<td>Rose Curve</td>
</tr>
<tr>
<td></td>
<td>Spiral</td>
</tr>
<tr>
<td></td>
<td>Limacon</td>
</tr>
<tr>
<td></td>
<td>Lemniscate</td>
</tr>
<tr>
<td></td>
<td>Rectangular</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Engaging Experience 1
Title: Converting Between Polar and Rectangular on the White Boards
Suggested Length of Time: ½ class period
Standards Addressed

Priority:

● CBIMVI.3.2.1 Expresses points in the plane in both rectangular and polar forms.

Detailed Description/Instructions: The students will use trig to convert points from polar to rectangular and rectangular to polar. The students will be given polar equations to convert to rectangular and rectangular equations to convert to polar.

Bloom’s Levels: Understand

Webb’s DOK: 2

Rubric: N/A
Topic 2: Graph in the Polar Plane

Engaging Experience 1
Title: Exploring the Graphs of Polar Equations
Suggested Length of Time: ½ class period

Standards Addressed

Priority:
- MOPA2.6: Graph using polar coordinates.

Supporting:
- ISTE-CREATIVE COMMUNICATOR.6.A - choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.

Detailed Description/Instructions: Groups of students will be given a collection of polar equations to graph on the graphing calculator or Desmos. They will then make generalizations about the relationship between the curves and the equations. Each group will share their discovery.

Bloom’s Levels: Apply
Webb’s DOK: 2
Rubric: N/A
Engaging Experience 1
Title: Complex Numbers in Polar Form
Suggested Length of Time: ½ class period
Standards Addressed
  Supporting:
    ● CBIMVI.2.2.2 Relates and uses rectangular and polar representations of complex numbers, and uses DeMoivre’s theorem.
Detailed Description/Instructions: Students in small groups will graph complex numbers in the rectangular plane and then apply knowledge of converting points to polar to develop formulas for converting complex numbers to polar form. Students will then work with operations on complex form in polar form.
Bloom’s Levels: Analyze
Webb’s DOK: 2
Rubric: N/A
**Engaging Scenario**

An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.

Each student will choose a selection of polar curves such as roses, limacons, circles, and lemniscates to create an artistic picture. They will graph in Desmos and then print. Their picture can be enhanced with color. The picture, with equations of curves, will be presented to the class. The class could then judge the most original/attractive.

**Rubric for Engaging Scenario:** to be created
## Summary of Engaging Learning Experiences for Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert to Polar</td>
<td>Converting Between Polar and Rectangular on the White Boards</td>
<td>The students will use trig to convert points from polar to rectangular and rectangular to polar. The students will be given polar equations to convert to rectangular and rectangular equations to convert to polar.</td>
<td>½ class period</td>
</tr>
<tr>
<td>Graph in the Polar Plane</td>
<td>Exploring the Graphs of Polar Equations</td>
<td>Groups of students will be given a collection of polar equations to graph on the graphing calculator or Desmos. They will then make generalizations about the relationship between the curves and the equations. Each group will share their discovery.</td>
<td>½ class period</td>
</tr>
<tr>
<td>Complex Numbers</td>
<td>Complex Numbers in Polar Form</td>
<td>Students in small groups will graph complex numbers in the rectangular plane and then apply knowledge of converting points to polar to develop formulas for converting complex numbers to polar form. Students will then work with operations on complex form in polar form.</td>
<td>½ class period</td>
</tr>
</tbody>
</table>
Unit of Study Terminology

**Appendices:** All Appendices and supporting material can be found in this course’s shell course in the District’s Learning Management System.

**Assessment Leveling Guide:** A tool to use when writing assessments in order to maintain the appropriate level of rigor that matches the standard.

**Big Ideas/Enduring Understandings:** Foundational understandings teachers want students to be able to discover and state in their own words by the end of the unit of study. These are answers to the essential questions.

**Engaging Experience:** Each topic is broken into a list of engaging experiences for students. These experiences are aligned to priority and supporting standards, thus stating what students should be able to do. An example of an engaging experience is provided in the description, but a teacher has the autonomy to substitute one of their own that aligns to the level of rigor stated in the standards.

**Engaging Scenario:** This is a culminating activity in which students are given a role, situation, challenge, audience, and a product or performance is specified. Each unit contains an example of an engaging scenario, but a teacher has the ability to substitute with the same intent in mind.

**Essential Questions:** Engaging, open-ended questions that teachers can use to engage students in the learning.

**Priority Standards:** What every student should know and be able to do. These were chosen because of their necessity for success in the next course, the state assessment, and life.

**Supporting Standards:** Additional standards that support the learning within the unit.

**Topic:** These are the main teaching points for the unit. Units can have anywhere from one topic to many, depending on the depth of the unit.

**Unit of Study:** Series of learning experiences/related assessments based on designated priority standards and related supporting standards.

**Unit Vocabulary:** Words students will encounter within the unit that are essential to understanding. Academic Cross-Curricular words (also called Tier 2 words) are those that can be found in multiple content areas, not just this one. Content/Domain Specific vocabulary words are those found specifically within the content.

**Symbols:**
- This symbol depicts an experience that can be used to assess a student’s 21st Century Skills using the rubric provided by the district.
- This symbol depicts an experience that integrates professional skills, the development of professional communication, and/or the use of professional mentorships in authentic classroom learning activities.