



Mathematics Curriculum Guide

Honors Geometry

2017-18



Topic 7: Trigonometry

In this unit, students explore concepts related to right triangles, including trigonometry. Students will find side lengths or angle measure in right triangles using the Pythagorean Theorem (and its converse), concepts of 30-60-90 and 45-45-90 triangles, as well as trigonometric ratios to form proportions. Additionally, students will use inverse trig ratios and geometric reasoning to determine an angle of depression.

Common Misconceptions and/or Errors:

- **Pythagorean Theorem:** When using the Pythagorean Theorem to classify a triangle as right, obtuse, or acute, conditions for obtuse and acute can be confused because they seem to be counterintuitive.
 - **For example:** A triangle has side lengths 7, 15, and 18. Is it acute, obtuse, or right? See below. The student might conclude that the triangle is acute instead of obtuse.
 - $18^2 > (?)7^2 + 15^2$
 - $324 > (?)49 + 225$
 - $324 > 274$
- **30°-60°-90° and 45°-45°-90° Triangles:** Often students are unsure of how to solve for a side length when they are not given the length of the shortest side in a 30°-60°-90° triangle. Instruct students to set up an equation with x and solve.
- **Trigonometric Ratios:** Students may get confused about when to use the trigonometric functions and when to use the inverse trigonometric functions. Instruct students always to write the equations setting the trigonometric term equal to a ratio. Then, they will see if they need to use the inverse.



Topic 7: Trigonometry

Transfer Goals

- 1) Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution.
- 2) Effectively communicate orally, in writing, and using models (e.g., concrete, representational, abstract) for a given purpose and audience.
- 3) Construct viable arguments and critique the reasoning of others using precise mathematical language.

Timeframe: 14 days
Start Date: February 9, 2018
Assessment Dates: Mar. 1-2, 2018

Standards

G-SRT - Similarity, Right Triangles, and Trigonometry
– Define trigonometric ratios and solve problems involving right triangles

G-SRT-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.

G-SRT-7 Explain and use the relationship between the sine and cosine of complementary angles.

G-SRT-8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★

G-SRT-8.1 Derive and use the trigonometric ratios for special right triangles (30° , 60° , 90° and 45° , 45° , 90° triangles) CA

Meaning-Making

Understandings

Students will understand that...

- If the lengths of any two sides of a right triangle are known, the length of the third side can be found by using the Pythagorean Theorem. **(G-SRT 8)**
- Certain right triangles ($45^\circ - 45^\circ - 90^\circ$ and $30^\circ - 60^\circ - 90^\circ$) have properties that allow their side lengths to be determined without using the Pythagorean Theorem. **(G-SRT 8.1)**
- If certain combinations of side lengths and angle measures of a right triangle are known, ratios can be used to find other side lengths and angle measures. **(G-SRT 6, G-SRT 7, G-SRT 8, G-SRT 8.1)**
- There is a relationship between the sine and cosine of complementary angles. **(G-SRT 7)**
- The angles of elevation and depression are the acute angles of right triangles formed by a horizontal distance and a vertical height. **(G-SRT 8)**

Essential Questions

Students will keep considering...

- How can you use the Pythagorean Theorem, Triangle Theorems for Special Right Triangles, and trigonometric ratios to find a missing side length or angle measure in a right triangle? **(G-SRT 6, G-SRT 7, G-SRT 8, G-SRT 8.1)**
- How do trigonometric ratios relate to similar right triangles? **(G-SRT 6, G-SRT 7, G-SRT 8, G-SRT 8.1)**

Acquisition

Knowledge

Students will know...

Vocabulary: Pythagorean triple, sine, cosine, tangent, trigonometric ratios, inverse, complementary, angle of depression, angle of elevation

Concepts:

- Pythagorean Theorem & Converse (theorems 8-2, 8-3 and 8-4)
- $45^\circ - 45^\circ - 90^\circ$ and $30^\circ - 60^\circ - 90^\circ$ Triangle Theorems 8-5 and 8-6
- Trigonometric Ratios for sine, cosine, and tangent

Skills

Students will be skilled at and able to do the following...

- Use the Pythagorean Theorem and its converse to find the length of a missing side (in simplest radical form) in a right triangle.
- Use the Pythagorean Theorem to identify a right triangle and to classify triangles.
- Find the value of a missing side (in simplest radical form) using properties of special right triangles ($45^\circ - 45^\circ - 90^\circ$ and $30^\circ - 60^\circ - 90^\circ$).
- Use trigonometric ratios to determine side lengths and angle measures in a right triangle.
- Express $\sin A$, $\cos A$, and $\tan A$ as ratios.
- Describe and use angles of elevation and depression to solve problems.



Topic 7: Trigonometry

Transfer is a student’s ability to independently apply understanding in a novel or unfamiliar situation. In mathematics, this requires that students use reasoning and strategy, not merely plug in numbers in a familiar-looking exercise, via a memorized algorithm.

Transfer goals highlight the effective uses of understanding, knowledge, and skills we seek in the long run – that is, what we want students to be able to do when they confront new challenges, both in and outside school, beyond the current lessons and unit. These goals were developed so all students can apply their learning to mathematical or real-world problems while simultaneously engaging in the Standards for Mathematical Practices. In the mathematics classroom, assessment opportunities should reflect student progress towards meeting the transfer goals.

With this in mind, the revised **PUSD transfer goals** are:

- 1) **Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution.**
- 2) **Effectively communicate orally, in writing, and by using models (e.g., concrete, representational, abstract) for a given purpose and audience.**
- 3) **Construct viable arguments and critique the reasoning of others using precise mathematical language.**

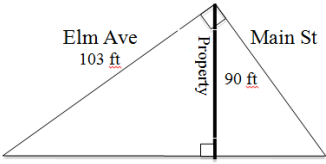
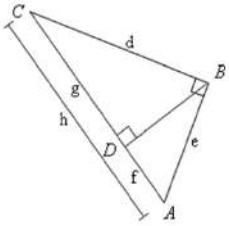
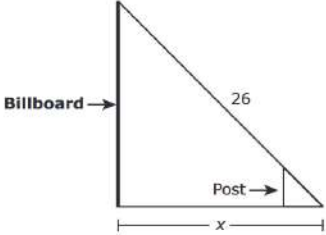
Multiple measures will be used to evaluate student acquisition, meaning-making and transfer. Formative and summative assessments play an important role in determining the extent to which students achieve the desired results in stage one.

Formative Assessment	Summative Assessment
Aligning Assessment to Stage One	
<ul style="list-style-type: none"> • What constitutes evidence of understanding for this lesson? • Through what other evidence during the lesson (e.g. response to questions, observations, journals, etc.) will students demonstrate achievement of the desired results? • How will students reflect upon, self-assess, and set goals for their future learning? 	<ul style="list-style-type: none"> • What evidence must be collected and assessed, given the desired results defined in stage one? • What is evidence of understanding (as opposed to recall)? • Through what task(s) will students demonstrate the desired understandings?
Opportunities	
<ul style="list-style-type: none"> • Discussions and student presentations • Checking for understanding (using response boards) • Ticket out the door, Cornell note summary, and error analysis • <i>Performance Tasks</i> within a Unit • Teacher-created assessments/quizzes 	<ul style="list-style-type: none"> • Unit assessments • Teacher-created quizzes and/or mid-unit assessments • <i>Illustrative Mathematics</i> tasks (https://www.illustrativemathematics.org/) • Performance tasks



Topic 7: Trigonometry

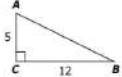
The following pages address how a given skill may be assessed. Assessment guidelines, examples and possible question types have been provided to assist teachers in developing formative and summative assessments that reflect the rigor of the standards. *These exact examples cannot be used for instruction or assessment, but can be modified by teachers.*

Unit Skills	SBAC Targets (DOK)	Standards	Examples
<ul style="list-style-type: none"> Use the Pythagorean Theorem and its converse to find the length of a missing side (in simplest radical form) in a right triangle. Use the Pythagorean Theorem to identify a right triangle and to classify triangles. Find the value of a missing side (in simplest radical form) using properties of special right triangles ($45^\circ - 45^\circ - 90^\circ$ and $30^\circ - 60^\circ - 90^\circ$). Use trigonometric ratios to determine side lengths and angle measures in a right triangle. Express $\sin A$, $\cos A$, and $\tan A$ as ratios. Describe and use angles of elevation and depression to solve problems. 	<p>Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. (3,4)</p> <p>State logical assumptions being used. (2,3)</p> <p>Distinguish correct logic or reasoning from that which is flawed and – if there is a flaw in the argument – explain what it is. (2,3,4)</p> <p>Base arguments on concrete referents such as objects, drawings, diagrams, and actions. (2,3)</p> <p>Determine conditions under which an argument does and does not apply. (3,4)</p>	<p>G-SRT-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.</p> <p>G-SRT-7. Explain and use the relationship between the sine and cosine of complementary angles.</p> <p>G-SRT-8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★</p> <p>G-SRT-8.1 Derive and use the trigonometric ratios for special right triangles (30°, 60°, 90° and 45°, 45°, 90° triangles) CA</p>	<p>Two homeowners live on Elm Ave and Main St as shown in the diagram below. They want to separate and fence their plots of land. The property line will have a shared fence that needs to be 90 feet long. Both homeowners want to fence their property. The Elm Ave side of the property is 103 feet long. What is the amount of fencing needed for each plot of land?</p>  <p>Figure not drawn to scale.</p>  <p>Given: $\triangle ABC$ is a right triangle, where angle B is the right angle and $\overline{BD} \perp \overline{AC}$. Prove: $e^2 + d^2 = h^2$</p> <p>10. A billboard at ground level has a support length of 26 feet that extends from the top of the billboard to the ground. A post that is 5 feet tall is attached to the support and is 4 feet from where the base of the support is attached to the ground. In the figure shown, the distance, in feet, from the base of the billboard to the base of the support is labeled x.</p>  <p>Create an equation that can be used to determine x. Discuss any assumptions that should be made concerning the equation. Use your equation to find the value of x. Show your work or explain your answer.</p> <p>Enter your equation, assumptions, answer, and work or explanation in the space provided.</p>



Topic 7: Trigonometry

The following pages address how a given skill may be assessed. Assessment guidelines, examples and possible question types have been provided to assist teachers in developing formative and summative assessments that reflect the rigor of the standards. *These exact examples cannot be used for instruction or assessment, but can be modified by teachers.*

Unit Skills	SBAC Targets (DOK)	Standards	Examples																																														
<ul style="list-style-type: none"> Use the Pythagorean Theorem and its converse to find the length of a missing side (in simplest radical form) in a right triangle. Use the Pythagorean Theorem to identify a right triangle and to classify triangles. Find the value of a missing side (in simplest radical form) using properties of special right triangles ($45^\circ - 45^\circ - 90^\circ$ and $30^\circ - 60^\circ - 90^\circ$). Use trigonometric ratios to determine side lengths and angle measures in a right triangle. Express $\sin A$, $\cos A$, and $\tan A$ as ratios. Describe and use angles of elevation and depression to solve problems. 	<p>Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. (3,4)</p> <p>State logical assumptions being used. (2,3)</p> <p>Distinguish correct logic or reasoning from that which is flawed and – if there is a flaw in the argument – explain what it is. (2,3,4)</p> <p>Base arguments on concrete referents such as objects, drawings, diagrams, and actions. (2,3)</p> <p>Determine conditions under which an argument does and does not apply. (3,4)</p>	<p>G-SRT-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.</p> <p>G-SRT-7. Explain and use the relationship between the sine and cosine of complementary angles.</p> <p>G-SRT-8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★</p> <p>G-SRT-8.1 Derive and use the trigonometric ratios for special right triangles (30°, 60°, 90° and 45°, 45°, 90° triangles) CA</p>	<div data-bbox="1010 477 1640 862"> <p>682</p> <p>Consider triangle ABC, where angle C is a right angle.</p> <p>Drag possible measures of angle A into the correct column.</p> <table border="1"> <thead> <tr> <th>$\cos A < \sin A$</th> <th>$\cos A = \sin A$</th> <th>$\cos A > \sin A$</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Possible Measures of Angle A</p> <table border="1"> <tr> <td>5°</td> <td>25°</td> <td>35°</td> <td>45°</td> <td>15°</td> </tr> <tr> <td>55°</td> <td>65°</td> <td>75°</td> <td>85°</td> <td></td> </tr> </table> </div> <p>For this item, a full-credit response (2 points) includes:</p> <ul style="list-style-type: none"> $55^\circ, 65^\circ, 75^\circ,$ and 85° in the "$\cos A < \sin A$" column AND 45° in the "$\cos A = \sin A$" column AND $5^\circ, 15^\circ, 25^\circ,$ and 35° in the "$\cos A > \sin A$" column <p>For partial credit (1 point), the student correctly fills out 2 columns.</p> <div data-bbox="1528 922 2011 1500"> <p>1936</p> <p>Consider this right triangle.</p>  <p>Determine if each expression is equivalent to the length of \overline{AC}. Select Yes or No for each expression.</p> <table border="1"> <thead> <tr> <th></th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>$13\sin(B)$</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>$13\cos(A)$</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>$12\tan(A)$</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>$12\tan(B)$</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p>Exemplar: (shown at right)</p> <table border="1"> <thead> <tr> <th></th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>$13\sin(B)$</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>$13\cos(A)$</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>$12\tan(A)$</td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>$12\tan(B)$</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p>Rubric: (1 point) Student correctly identifies each expression equal to the length of \overline{AC} (YYNY).</p> </div>	$\cos A < \sin A$	$\cos A = \sin A$	$\cos A > \sin A$				5°	25°	35°	45°	15°	55°	65°	75°	85°			Yes	No	$13\sin(B)$	<input type="checkbox"/>	<input type="checkbox"/>	$13\cos(A)$	<input type="checkbox"/>	<input type="checkbox"/>	$12\tan(A)$	<input type="checkbox"/>	<input type="checkbox"/>	$12\tan(B)$	<input type="checkbox"/>	<input type="checkbox"/>		Yes	No	$13\sin(B)$	<input checked="" type="checkbox"/>	<input type="checkbox"/>	$13\cos(A)$	<input checked="" type="checkbox"/>	<input type="checkbox"/>	$12\tan(A)$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	$12\tan(B)$	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$\cos A < \sin A$	$\cos A = \sin A$	$\cos A > \sin A$																																															
5°	25°	35°	45°	15°																																													
55°	65°	75°	85°																																														
	Yes	No																																															
$13\sin(B)$	<input type="checkbox"/>	<input type="checkbox"/>																																															
$13\cos(A)$	<input type="checkbox"/>	<input type="checkbox"/>																																															
$12\tan(A)$	<input type="checkbox"/>	<input type="checkbox"/>																																															
$12\tan(B)$	<input type="checkbox"/>	<input type="checkbox"/>																																															
	Yes	No																																															
$13\sin(B)$	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																															
$13\cos(A)$	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																															
$12\tan(A)$	<input type="checkbox"/>	<input checked="" type="checkbox"/>																																															
$12\tan(B)$	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																															



Topic 7: Trigonometry

Transfer Goals

- 1) Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution.
- 2) Effectively communicate orally, in writing, and using models (e.g., concrete, representational, abstract) for a given purpose and audience.
- 3) Construct viable arguments and critique the reasoning of others using precise mathematical language.

Essential Questions:

- How can you use the Pythagorean Theorem, Triangle Theorems for Special Right Triangles, and ratios to find a side length or angle measure in a right triangle?
- How do trigonometric ratios relate to similar right triangles?

Standards: G-SRT 6, G-SRT 7, G-SRT 8, G-SRT 8.1

Suggested Timeframe: 14 days

Start Date: February 9, 2018

Assessment Dates: March 1-2, 2018

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Resources
2 days	<p>Lesson 8-1: <i>The Pythagorean Theorem and Its Converse</i> (pp. 491-498) SMP: 1,3,4,8 G-SRT-4, G-SRT-8</p>	<p>Focus Question:</p> <ul style="list-style-type: none"> • What is the difference between how the Pythagorean Theorem and its converse are used? <p>Inquiry Question: p. 491 Solve It!</p>	<ul style="list-style-type: none"> • The Pythagorean Theorem is used to determine the length of the third side of a right triangle given two of the sides. • The converse is used to determine if three given side lengths form a right triangle. 	<p>Vocabulary: Pythagorean Theorem, Pythagorean triple, converse, hypotenuse, leg</p> <p>Concepts:</p> <ul style="list-style-type: none"> • Pythagorean Theorem • Converse of the Pythagorean Theorem • Theorems 8-2, 8-3 and 8-4 	<ul style="list-style-type: none"> • Use the Pythagorean Theorem and its converse to find the length of a missing side (in simplest radical form and as a decimal) in a right triangle. • Use the Pythagorean Theorem to classify a triangle as right, acute, or obtuse. 	<p>Common Core Problems: 8-1: #5,6,33, 43-48, 49, 50, 51, 52-54, 55-58</p>

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
2 Days	<p>Lesson 8-2: Special Right Triangles (pp. 499-505) SMP: 1,3,4</p> <p>G-SRT-8.1</p>	<p>Focus Question(s):</p> <ul style="list-style-type: none"> • What are special right triangles? • Why are they studied? <p>Inquiry Question: p. 499 Solve It!</p>	<ul style="list-style-type: none"> • Certain right triangles ($45^\circ - 45^\circ - 90^\circ$ and $30^\circ - 60^\circ - 90^\circ$) have properties that allow their side lengths to be determined without using the Pythagorean Theorem. 	<p>Vocabulary: special right triangles</p> <p>Concepts:</p> <ul style="list-style-type: none"> • $45^\circ - 45^\circ - 90^\circ$ Triangle Theorem • $30^\circ - 60^\circ - 90^\circ$ Triangle Theorem 	<ul style="list-style-type: none"> • Find the value of a missing side (in simplest radical form) using properties of special right triangles ($45^\circ - 45^\circ - 90^\circ$ and $30^\circ - 60^\circ - 90^\circ$). 	<p>*It might be helpful to do mixed review with SRT and Pythag. Theorem to help students differentiate</p> <p>Common Core Problems: 8-2: #5,6,29, 31, 29, 30, 31, 32, 33</p>
3 days	<p>Lesson 8-3: Trigonometry (pp. 507-513) SMP: 1,3,4,6</p> <p>G-SRT-8, G-SRT-7, G-MG 1</p>	<p>Focus Question(s):</p> <ul style="list-style-type: none"> • How can we use what we know about triangle similarity and ratios to help determine side lengths and angle measures in right triangles? <p>Inquiry Question: p. 507 Solve It!</p>	<ul style="list-style-type: none"> • If you know certain combinations of side lengths and angle measures of a right triangle, you can use ratios to find other side lengths and angle measures. • Any two right triangles that have a pair of congruent acute angles are similar by the AA Similarity Postulate. • Similar right triangles have equivalent ratios for their corresponding sides called trigonometric ratios. 	<p>Vocabulary: trigonometric ratios, sine, cosine, tangent, opposite, adjacent, complementary, hypotenuse, inverse</p> <p>Concepts:</p> <ul style="list-style-type: none"> • Trigonometric Ratios for sine, cosine, and tangent 	<ul style="list-style-type: none"> • Use the trigonometric (sine, cosine, and tangent) ratios to determine side lengths and angle measures in right triangles. • Express $\sin A$, $\cos A$, and $\tan A$ as ratios. • Use inverse functions to find missing angle measures in right triangles • Use the relationship between sine and cosine of complementary angles. 	<p>* Students might need review on order of operations and solving equations with fractions prior to this section.</p> <p>Common Core Problems: 8-3: #9, 10, 29, 36, 37, 53</p>
1 day	<p>Lesson 8-4: Angles of Elevation and Depression (pp. 516-521) SMP: 1,3,4,6</p> <p>G-SRT-8</p>	<p>Focus Question(s):</p> <ul style="list-style-type: none"> • How can you identify angles of elevation and depression, and how can these angles help you solve problems? <p>Inquiry Question: p. 516 Solve It!</p>	<ul style="list-style-type: none"> • You can use the angles of elevation and depression as the acute angles of right triangles formed by a horizontal distance and a vertical height. 	<p>Vocabulary: angle of elevation, angle of depression</p> <p>Concepts:</p> <ul style="list-style-type: none"> • Procedures for using the angle of elevation and angle of depression to solve problems. 	<ul style="list-style-type: none"> • Identify and describe angles of elevation and depression • Use angles of elevation and depression to solve problems. 	<p>Common Core Problems: 8-4: #7, 8, 9-16, 19, 22, 23, 24, 29, 33, 34, 35</p>

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
4 Days	<p style="text-align: center;">Review Topic 7 Concepts & Skills</p> <p style="text-align: center;">This includes two extra days for Smarter Balance Interim Assessment Blocks scheduled for week of 2/26 – 3/2.</p>					
2 Days	<p style="text-align: center;">Topic 7 Assessment</p> <p style="text-align: center;">(Created and provided by PUSD)</p>					

This page is blank.