Unit 6: Right Triangles and Trigonometry

Content Area: **Mathematics**
Course(s): **Geometry Honors 8**
Time Period: **January**
Length: **4 weeks**
Status: **Published**

Transfer

Previous coursework: explain a proof of the pythagorean theorem and its converse, apply the pythagorean theorem

By the end of this unit: Students should understand what a trig ratio is; what does it mean when we say "sin 32^{o}"? They should focus on patterns and relationships with basic co-functions and complementary angles and problems should be solved using any of the six trig functions. Because they will be graphing trig functions in Algebra 2, they should be able to derive the sine and cosine of a 30, 45, and 60 degree angle easily. Honors students extend this knowledge to oblique triangles using Law of Sines and Cosines and the unit circle. The honors student should be able to quickly calculate any trig value on the unit circle given an angle with a 30, 45, or 60 degree reference angle. They should be able to do this with both degree or radian measures less than one rotation (between 0 and 360/2pi).

Instructional strategies:

- Students have a hard time labeling side lengths- highlight the reference angle in some way to help.
- All six trig functions should be used to solve a right triangle.
- Honors: Derive the Law of Sines and Cosines using algebra and make sure to address the Law of Sines Ambiguous Case.
- Honors: The unit circle is a tool to get students to the trig values for the special angles- do NOT allow them to just memorize the values! At a certain point, they should calculate the values using special right triangles and determine the sign using the quadrant of the unit circle.
- Honors: Radian measure is challenging for students- allow time for them to discover the concept and make their own definitions. Then help them to formalize the definition and create analogies for visualization.
- (+) = denotes Honors only skill not on PARCC

Essential Questions

How is trigonometry related to similar right triangles?

How can trigonometry be used in real life?

Enduring Understandings

Trigonometry uses properties of similar right triangles to determine common ratios between side lengths and acute angle measures.

Trigonometry can find lengths and angles given limited information

Standards in Mathematics

MA.K-12.1	Make sense of problems and persevere in solving them. Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.
MA.K-12.2	Reason abstractly and quantitatively. Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.
MA.K-12.4	Model with mathematics. Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that

	these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
MA.K-12.7	Look for and make use of structure.
	Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x +$ 14, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.
MA.G-SRT.B	Prove theorems involving similarity
MA.G-SRT.B.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
MA.G-SRT.C	Define trigonometric ratios and solve problems involving right triangles
MA.G-SRT.C.6	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
MA.G-SRT.C.7	Explain and use the relationship between the sine and cosine of complementary angles.
MA.G-SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
MA.G-SRT.D	Apply trigonometry to general triangles
MA.G-SRT.D.9	Derive the formula $A = (1/2)ab\ sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
MA.G-SRT.D.10	Prove the Laws of Sines and Cosines and use them to solve problems.
MA.G-SRT.D.11	Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).
MA.8.G.B	Understand and apply the Pythagorean Theorem.
MA.8.G.B.6	Explain a proof of the Pythagorean Theorem and its converse.
MA.8.G.B.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
MA.8.G.B.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Critical Knowledge and Skills

Vocabulary

Special Right Triangles

Finding Sides and Angles using Trigonometric Ratios

Applications of Trigonometry

Law of Sines and Cosines (+)

Unit Circle Trigonometry (+)

Learning Objectives

Solve for sides and angles in the special right triangles.

Label a triangle in relation to the reference angle (opposite, adjacent & hypotenuse).

Determine the most appropriate trigonometric ratio (sine, cosine, tangent, cosecant, secant, cotangent) to use for a given problem based on the information provided.

Solve for sides and angles of right triangles using trigonometry.

Explain why similar triangles have the same trigonometric ratio values

Determine the exact value of the trigonometric ratios for 30, 45, and 60 degree angles

Use trigonometry to solve application problems, including angle of elevation and depression

Explain and use the relationship between the sine and cosine of complementary angles

Derive the Law of Sines and Cosines (+)

Use the Law of Sines and Cosines to solve right and oblique triangles (+)

Derive the SAS area formula from the Law of Sines (+)

Define radian measure as the length of the arc on the unit circle subtended by the angle (+)

Calculate exact values for all six trigonometric ratios for any radian or degree measure around the unit circle (+)

Resources

Pearson Resources:

8-1, 8-2, 8-3, 8-4, CB 8-4 (both CP and Honors)

10-5, 8-5, 8-6 (Honors Only)

Online Resources:

- http://jdevarona.wordpress.com/2013/02/18/random-problem-idea-the-giant-bat/
- http://map.mathshell.org/materials/lessons.php?taskid=222&subpage=problem
- http://mrhonner.com/archives/6153
- https://www.illustrativemathematics.org/illustrations/1635
- https://www.illustrativemathematics.org/illustrations/1443
- https://www.illustrativemathematics.org/HSG-SRT.C.8 (there's 6 in this link)