04 Right Triangles and Trigonometry

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **4-5 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

NJSLS Geometry Overview

In this unit students connect the relationships that exist in right triangles to the concept of similarity to develop the basis for right triangle trigonometry. Students explore right triangle relationships including the Pythagorean Theorem, similar right triangles created when an altitude is drawn to a hypotenuse, and special right triangles (45-45-90 and 30-60-90). Students are then introduced to the sine, cosine, and tangent ratios. Students learn how to determine the trig ratios for a given right triangle and then how to use these ratios to calculate missing side lengths in right triangles. Inverse trig functions are introduced and utilized to calculate missing angles measures. These concepts are combined to allow students to solve right triangles and connect these ideas to a variety of application questions.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives:

- Students will be able to solve right triangles using the Pythagorean Theorem, Trigonometric ratios, and inverse trig functions.
- Students will recognize that the Pythagorean Theorem can be proven using similar right triangles created by an altitude drawn to the hypotenuse
- Students will utilize right triangle and trigonometric relationships to model and solve problems.

Essential Questions:

- How do right triangles and similarity server as the foundation for Trigonometry?
- What specific relationships exist among right triangles that aid in problem solving?

Enduring Understandings:

- By AA similarity, any two right triangles with corresponding congruent acute angles must be similar, and therefore the exists a specific proportional relationship among the sides.
- Trigonometric functions can be used to solve for missing side lengths in right triangles if one side length and one acute angel are known.
- By applying the Pythagorean theorem to special right triangles, specific relationships among the side

lengths can be developed and applied to broader cases.
- Right triangle trigonometry serves as the foundation for wider applications of trigonometric relationships which are addressed in subsequent courses.

CONTENT AREA STANDARDS

MA.G-MG.A.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.7	Look for and make use of structure.
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.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).

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

CS.K-12.2.c	Solicit and incorporate feedback from, and provide constructive feedback to, team members and other stakeholders.
CS.K-12.2.d	Evaluate and select technological tools that can be used to collaborate on a project.
CS.K-12.3.a	Identify complex, interdisciplinary, real-world problems that can be solved computationally.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.
CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
LA.RH.9-10.4	Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history and the social sciences; analyze the cumulative impact of specific word choices on meaning and tone.
LA.RH.9-10.7	Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text, to analyze information presented via different mediums.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and

	phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.K-12.NJSLSA.R1	Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- The Pythagorean Theorem can be used to find the missing length of a right triangle when two other sides are given.
- The hypotenuse is the largest length of any right triangle, and is located across from its right angle.
- When applying $a^2 + b^2 = c^2$, the length "c" refers to the length of the hypotenuse and "a" and "b" refer to the lengths of the legs in any order.
- The value of the radicand may be simplified if the value contains a factor which is a perfect square.
- When the length of the three sides of a right triangle are whole numbers, these triangle triangles are referred to as "Pythagorean Triples"
- An isosceles right triangle can be referred to as a "45 45 90" triangle.
- A formula may applied to find either the hypotenuse or the leg of a "45 45 90" triangle
- Two "45 45 90" triangles are created by forming one diagonal of a square.
- When an altitude of an equilateral triangle is formed, it creates two triangles with angle measures of 30, 60 and 90 degrees which will be referred to as a "30 60 90" triangle
- In a 30 60 90 triangle, the short leg is located across from the 30 degree angle, the long leg is located across from the 60 degree angle and the hypotenuse is located across from the right angle.
- A formula can be applied to find either the short leg, the long leg or the hyptonuse of a "30 60 90" triangle.
- When an acute angle of a right triangle does not meausre 30, 45 or 60 degrees, Trigonometric ratios of Sine, Cosine and Tangent relate side lengths in right triangles to each other based on specific angle measures
- Trigonometric ratios/functions can be used to calculate side lengths in right triangles
- Inverse trig functions can be used to calculate angle measures in right triangles
- Properties of right triangle trig can be extended to develop relationships for non-right triangles

Procedural Knowledge

Students will be able to:

- Create a factor tree or find factors that contain a perfect square of a radicand to simply a radical term into its most reduced form. *Comprehension*
- Label the hyptonuese of a right rriangle and apply the Pythagorean Theorem to find the length of a leg or the hypotenuse. *Comprehension*
- Identify the opposite side, adjacent side and hyptenuse of a right triangle and select the appropriate trigonometric ratio to form and solve an equation resulting in the length of a side of the triangle.*Analysis*
- Identify the opposite side, adjacent side and hyptenuse of a right triangle and select the appropriate inverse trigonometric ratio to form and solve an equation resulting in the measure of an acute angle of the triangle. *Analysis*
- Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.(★) *Analysis*
- Explain and use the relationship between the sine and cosine of complementary angles. *Comprehension*
- 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. *Comprehension*

EVIDENCE OF LEARNING

Formative Assessments

- Student feedback/questioning/observation
- Error analysis
- Specific skill assessment/questions
- Survey/polling
- Task completion and review of quizzes and material presented in the Geometry class

Summative Assessments

There will be no formal assessments in this course.

RESOURCES (Instructional, Supplemental, Intervention Materials)

NJ DOE Model Curriculum unit: Trigonometry

Illustrative Mathematics unit: Right Triangle Trigonometry

Khan Academy unit: Right Triangles and Trigonometry

NJCTL unit: Similar Triangles and Trigonometry

Desmos Activities: Pythagorean Triples and Similar Triangles, Special Right Triangles, Using Trigonometry to find the length of one side of a triangle, Trigonometry applications practice

Course approved textbook

Kuta Software worksheets

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations taken from business, physics, engineering, biology, statistics, geography, and numerous other fields. Examples can be found in topic specific textbook problems and digital resources.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.