

Unit 10: The Pythagorean Theorem

Cluster: Understand and apply the Pythagorean Theorem.

Nevada Academic Content Standard

What does this standard mean that a student will know and be able to do?
(adapted from North Carolina 8th Grade Standards, Unpacked Content)

8.G.B.6

Explain a proof of the Pythagorean Theorem and its converse.

8.G.6 Using models, students explain the Pythagorean Theorem, understanding that the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle.

Students also understand that given three side lengths with this relationship forms a right triangle.

Example 1:

The distance from Jonestown to Maryville is 180 miles, the distance from Maryville to Elm City is 300 miles, and the distance from Elm City to Jonestown is 240 miles. Do the three towns form a right triangle? Why or why not?

Solution: If these three towns form a right triangle, then 300 would be the hypotenuse since it is the greatest distance.

$$180^2 + 240^2 = 300^2$$

$$32,400 + 57,600 = 90,000$$

$$90,000 = 90,000 \checkmark$$

These three towns form a right triangle.

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.

8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Example 1:

The Irrational Club wants to build a tree house. They have a 9-foot ladder that must be propped diagonally against the tree. If the base of the ladder is 5 feet from the bottom of the tree, how high will the tree house be off the ground?

Solution:

$$a^2 + 5^2 = 9^2$$

$$a^2 + 25 = 81$$

$$a^2 = 56$$

$$\sqrt{a^2} = \sqrt{56}$$

$$a = \sqrt{56} \text{ or } \sim 7.5$$

8.G.B.8

Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Example 2:

Find the length of d in the figure to the right if $a = 8$ in, $b = 3$ in and $c = 4$ in.

Solution:

First find the distance of the hypotenuse of the triangle formed with legs a and b .

$$\begin{aligned}8^2 + 3^2 &= c^2 \\64 + 9 &= c^2 \\73 &= c^2 \\ \sqrt[2]{73} &= \sqrt[2]{c^2} \\ \sqrt[2]{73} &= \sqrt[2]{c^2}\end{aligned}$$

The $\sqrt[2]{73}$ is the length of the base of a triangle with c as the other leg and d is the hypotenuse.

To find the length of d :

$$\begin{aligned}(\sqrt[2]{73})^2 + 4^2 &= d^2 \\73 + 16 &= d^2 \\89 &= d^2 \\ \sqrt[2]{89} &= \sqrt[2]{d^2} \\ \sqrt[2]{89} \text{ in} &= d\end{aligned}$$

Based on this work, students could then find the volume or surface area.

8.G.8 One application of the Pythagorean Theorem is finding the distance between two points on the coordinate plane. Students build on work from 6th grade (finding vertical and horizontal distances on the coordinate plane) to determine the lengths of the legs of the right triangle drawn connecting the points. Students understand that the line segment between the two points is the length of the hypotenuse.

NOTE: The use of the distance formula is not an expectation.

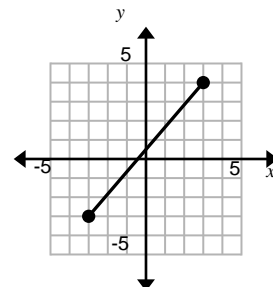
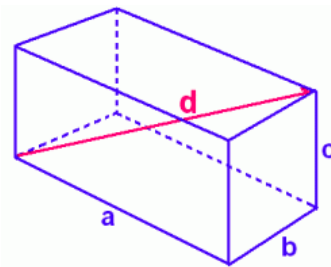
Example 1:

Find the length of line segment to the right.

Solution:

1. Form a right triangle so that the given line segment is the hypotenuse.
2. Use Pythagorean Theorem to find the distance (length) between the two points.

$$\begin{aligned}6^2 + 7^2 &= c^2 \\36 + 49 &= c^2\end{aligned}$$



$$85 = c^2$$

$$\sqrt{85} = \sqrt{c^2}$$

$$\sqrt{85} = c \text{ or approximately } 9.2 \text{ units}$$

Example 2:

Find the distance between (-2, 4) and (-5, -6).

Solution:

The distance between -2 and -5 is the horizontal length; the distance between 4 and -6 is the vertical distance.

Horizontal length: 3

Vertical length: 10

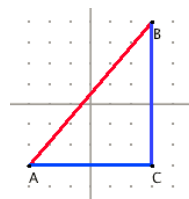
$$10^2 + 3^2 = c^2$$

$$100 + 9 = c^2$$

$$109 = c^2$$

$$\sqrt{109} = \sqrt{c^2}$$

$$\sqrt{109} = c$$



Students find area and perimeter of two-dimensional figures on the coordinate plane, finding the distance between each segment of the figure. (Limit one diagonal line, such as a right trapezoid or parallelogram.)

Approximate Time Frame: 2- 3 weeks

Terms:

- ✓ legs of a triangle
- ✓ hypotenuse
- ✓ right triangle
- ✓ Pythagorean Theorem
- ✓ Pythagorean triple
- ✓ Converse of Pythagorean Theorem
- ✓ square root
- ✓ distance formula
- ✓ irrational

Resources

- MGH – McGraw Hill, Glencoe Math (2015)
- ML – McDougal Littell, Pre-Algebra Book; Larson, 2005
- EX – Explorations in Core Math (Holt McDougal)
- LZ – Learn Zillion Website
- NY – Engage New York
- IL – Illinois Model Math Curriculum
- MAP – Math Assessment Project (MARS)

	Suggested Topics for Lessons	Possible Resources
8.G.B.7	Introduce and apply the	<ul style="list-style-type: none"> ➤ MGH 5-5 Inquiry Lab: <i>Right Triangle Relationships</i> (page 409) ➤ MGH 5-5 <i>The Pythagorean Theorem</i> (page 411) ➤ MGH 5-6 <i>Use the Pythagorean Theorem</i> (page 423) ➤ ML 9.3 <i>The Pythagorean Theorem</i> (page 465) ➤ EX 3-8 <i>The Pythagorean Theorem</i> (page 121)

	<p>Pythagorean Theorem</p> <p>SBAC Evidence:</p> <p>➤ The student solves real-world and mathematical problems of right triangles in two and three dimensions by applying the Pythagorean Theorem and its converse.</p>	<ul style="list-style-type: none"> ➤ NY Module 7, Topic C, Lesson 1: The Pythagorean Theorem ➤ Natl Science Foundation Video: Science of NFL Football: Pythagorean Theorem ➤ YouTube: The Best Pythagorean Rap Ever ➤ Video Alberta Math Interactives: Exploring the Pythagorean Theorem ➤ Prentice Hall Video Lesson: Using the Pythagorean Thm to find the hypotenuse ➤ LZ Video Lesson: Find the length of the hypotenuse of a right triangle ➤ Prentice Hall Video Lesson: Using the Pythagorean Theorem to find the leg ➤ VA Sample Lesson Plans: Pythagorean Theorem ➤ MAP Assessment Task: Jane's TV ➤ MAP Classroom Challenge: Discovering The Pythagorean Theorem ➤ LZ Video Lesson: Identify properties of right triangles ➤ NY Module 2, Topic D, Lesson 16: Applications of the Pythagorean Theorem ➤ NY Module 3, Topic C, Lesson 14: Converse of the Pythagorean Theorem ➤ NY Module 7, Topic C, Lesson 18: Applications of the Pythagorean Theorem ➤ Yummy Math (use Pythagorean Theorem): Watson save ➤ Khan Academy Skills Practice: 8G7 Determine Unknown Side Lengths ➤ LZ Lesson Plan: Recognize patterns that make Pythagorean Triples ➤ LZ Lesson Plan: Apply the Pythagorean Theorem to determine unknown side lengths ➤ LZ Lesson Plan: Model a solution to a real-world problem in 2 dimensions ➤ LZ Lesson Plan: Solve real-world problems in 3 dimensions ➤ Khan Academy : Pythagorean Theorem ➤ PBS Learning Media: The Pythagorean Theorem and 18th-Century Cranes
<p>8.G.B.6</p>	<p>Explain a proof of the Pythagorean Theorem and its converse</p>	<ul style="list-style-type: none"> ➤ MGH 5-6 Inquiry Lab: Proofs About the Pythagorean Theorem (pg 419) ➤ MGH 5-6 Use the Pythagorean Theorem (page 423) ➤ ML 9.3 Investigating Right Triangles (page 464) ➤ EX 3-9 Applying the Pythagorean Theorem and Its Converse (page 127) ➤ Khan Academy: Origami Proof of the Pythagorean Theorem ➤ 106 Approaches to proving the theorem: Pythagorean Theorem ➤ MAP Assessment Task: Proofs of the Pythagorean Theorem? ➤ NY Module 2, Topic D, Lesson 15: Informal Proof of the Pythagorean Theorem ➤ NY Module 3, Topic C, Lesson 13: Proof of the Pythagorean Theorem ➤ NY Module 7, Topic C, Lesson 15: Pythagorean Theorem, Revisited ➤ NY Module 7, Topic C, Lesson 16: Converse of the Pythagorean Theorem ➤ LZ Lesson Plan: Understand and explain a proof of the Pythagorean Theorem ➤ LZ Lesson Plan: Understand and apply the converse of the Pythagorean Theorem ➤ LZ Video Lesson: Use the Pythagorean Theorem to see if a triangle is

		<p><i>right</i></p> <ul style="list-style-type: none"> ➤ IL Lesson-Choose Lesson 1 of 3: <i>Pythagorean Theorem Proof and Converse</i> ➤ Khan Academy Skills Practice: <i>Explain a Proof of the Pythagorean Theorem</i> ➤ YouTube: <i>Pythagoras in 60 seconds</i> ➤ Slide Share: <i>The Egyptian Rope Stretchers</i> ➤ Foldable: <i>Pythagorean Theorem</i>
8.G.B.8	<p>Distance Formula</p> <p>SBAC Evidence:</p> <ul style="list-style-type: none"> ➤ The student finds the distance between two points in a coordinate system by applying the Pythagorean Theorem. 	<ul style="list-style-type: none"> ➤ <i>MGH 5-7 Distance on the Coordinate Plane (page 431)</i> ➤ <i>ML 9.5 The Distance Formula (page 476)</i> ➤ <i>NY Module 7, Topic C, Lesson 17: Distance on the Coordinate Plane</i> ➤ LZ Video Lesson: <i>Find distance between two points on the coordinate plane</i> ➤ LZ Lesson Plan: <i>Apply the Pythagorean Theorem to find the distance between two points in a coordinate system</i> ➤ Khan Academy Skills Practice: <i>Distance Formula</i>