

Geometry

Set 6: Understanding the Pythagorean Theorem

Instruction

Goal: To provide opportunities for students to develop concepts and skills related to understanding that the Pythagorean theorem is a statement about areas of squares on the sides of a right triangle

Common Core Standards

Geometry

Understand and apply the Pythagorean theorem.

- 8.G.6.** Explain a proof of the Pythagorean theorem and its converse.
- 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.
- 8.G.8.** Apply the Pythagorean theorem to find the distance between two points in a coordinate system.

Student Activities Overview and Answer Key

Station 1

Students draw a triangle and draw the area of each side squared. Then they try to fit the area of the legs squared into the area of the hypotenuse squared. They discuss how this illustrates the Pythagorean theorem.

Answers: Yes; the area of the two legs squared is equal to the area of the hypotenuse squared

Station 2

Students use the Pythagorean theorem to answer a question about the area of land. Then they use the Pythagorean theorem to find distance across a square. This allows students to use the Pythagorean theorem in two different ways for the same problem.

Answers: 5200 square feet; the Pythagorean theorem; about 72 feet

Station 3

Students work through a basic proof of the Pythagorean theorem. They use area to come up with the result.

Answers: c^2 ; $(\frac{1}{2})ab$; $2ab$; $c^2 + 2ab$

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Station 4

Students determine the area of the squares of two legs of a triangle and compare that to the area of the square of the hypotenuse. Then they explain how this demonstration is related to the Pythagorean theorem.

Answers: 25; 25; they are the same area total; it shows that the two legs squared are equal to the hypotenuse squared

Materials List/Setup

Station 1 pair of scissors, ruler, and pieces of paper for each group member

Station 2 none

Station 3 none

Station 4 none



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Discussion Guide

To support students in reflecting on the activities and to gather some formative information about student learning, use the following prompts to facilitate a class discussion to “debrief” the station activities.

Prompts/Questions

1. Why do you use squares to show the Pythagorean theorem in a physical way?
2. What is an example of a real-life situation when you would use the Pythagorean theorem?
3. If the area of a square coming off a leg of a right angle is 64 sq inches and the length of the hypotenuse is 10 sq inches, what is the area of the square coming off the other leg?
4. Explain how you could cut the squares that come off the sides of a right triangle into smaller pieces to find Pythagorean triples.

Think, Pair, Share

Have students jot down their own responses to questions, then discuss with a partner (who was not in their station group), then discuss as a whole class.

Suggested Appropriate Responses

1. In the Pythagorean theorem, the length of the sides are squared which is like finding the area of a square.
2. Many possibilities—finding the distance between two places if you know the horizontal and vertical distance
3. 36 sq inches
4. Example: 3, 4, 5 triangle—cut each square into 4 squares, then you have a 6, 8, 10 triangle

Possible Misunderstandings/Mistakes

- Taking the square root of the amount of land the oldest brother owns
 - Having trouble cutting the squares of the legs to fit into the square of the hypotenuse
 - Having trouble completing the proof, i.e., not understanding all the steps
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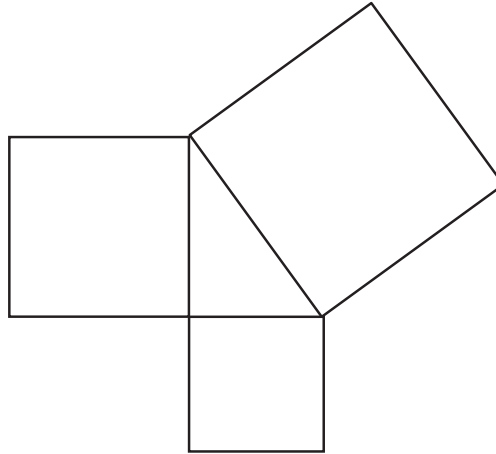
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Station 1

At this station, you will find a pair of scissors, a ruler, and a piece of paper for each group member. Each person should complete the activity and discuss his or her findings with the group.

Draw a right triangle. Now draw squares using each side of the triangle as one side of the squares. There should be three squares. Your figure will look like the one below.



Cut out the squares that are connected to the two legs of the triangle.

See if you can cut them up so they fit inside the square that is connected to the hypotenuse.

Can you? _____

The Pythagorean theorem states that $a^2 + b^2 = c^2$. How does this activity demonstrate that theorem?



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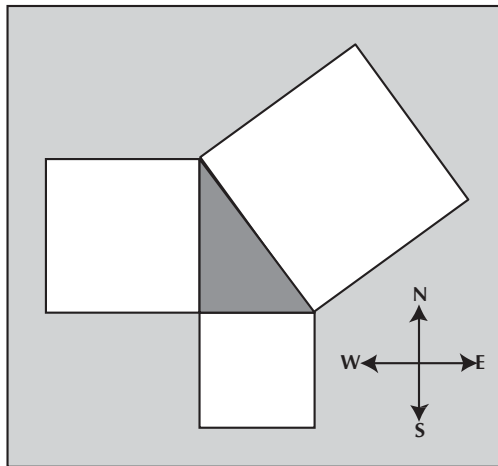
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Station 2

Discuss and answer the following questions as a group.

There are three brothers who own land around a park. The park is in the shape of a right triangle. The park looks like the triangle below. The only land the brothers own is what is directly touching the park (in white).



The youngest brother gets the land south of the park. His land is a perfect square, and he has 1600 square feet of land. The middle brother gets the land west of the park. His land is also a perfect square. He has 3600 square feet of land. The oldest brother gets the land that is along the longest section of the park. His land is also a perfect square.

How much land does the oldest brother have? _____

Explain your strategy for solving this problem.

If the oldest brother walked the diagonal across his property, how far would he walk?

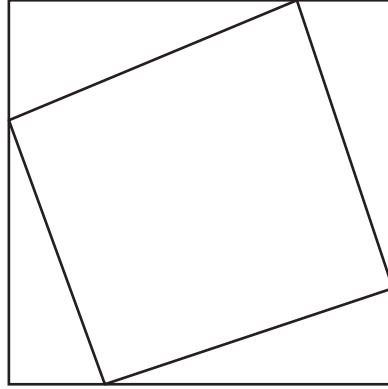
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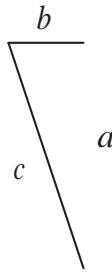
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Station 3

In this activity, you will use a diagram and the area of the diagram to prove the Pythagorean theorem. Look at the diagram below. It is made up of four triangles put together.



For the purpose of this proof, look at the triangle below.



Now label the sides of the four triangles in the original diagram with a , b , and c . Work together to answer these questions.

What is the area of the small square? _____

What is the area of one of the triangles? _____

What is the area of the four triangles? _____

What is the area of the large square? _____



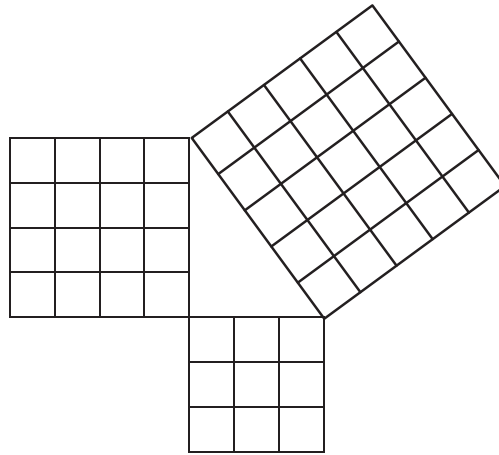
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Station 4

At this station, you will explore the Pythagorean theorem and see how it relates to the area of squares. As a group, discuss and answer the questions below.



In the figure above, number the boxes in squares that are attached to the two legs of the right triangle (1, 2, 3, etc.).

How many total squares are there? _____

Number the boxes in the square that is attached to the hypotenuse.

How many total squares are there? _____

What do you notice? _____

How does this represent the Pythagorean theorem?

