Pythagorean Theorem Activities: 7th and 8th Grade

$$(leg_1)^2 + (leg_2)^2 = hypotenuse^2$$

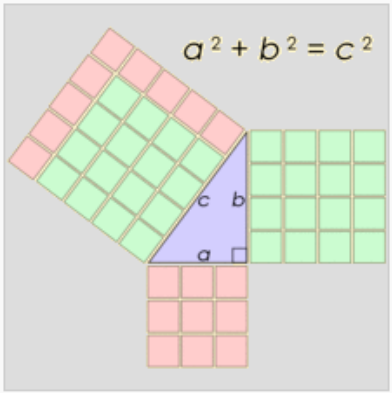
Standard: MG3.3 Know and understand the Pythagorean theorem and its converse and use it to find the length of the missing side of a right triangle and the lengths of other line segments and, in some situations, empirically verify the Pythagorean theorem by direct measurement.

Materials: Handouts, centimeter ruler, chalk and a measuring tape for each student

Debrief Warm - Up (handout and answer key included):

One Minute Math History of Pythagoras (optional):

Thousands of years ago, in the 6th century BCE in Greece, Pythagoras was the leader of a kind of math and philosophy religious movement. Pythagoras is famous for the Pythagorean Theorem named after him which states that for right triangles, $a^2 + b^2 = c^2$. This means that if you square the lengths of the smaller two sides of a right triangle and add those values together, you get the square of the length of the longest side. Long before Pythagoras lived, people in Babylonia (in present-day Iraq) and in India knew about that pattern in right triangles and had been using it for centuries, but Pythagoras is credited with proving it.



Pythagorean Triples (handout included - print in high quality):

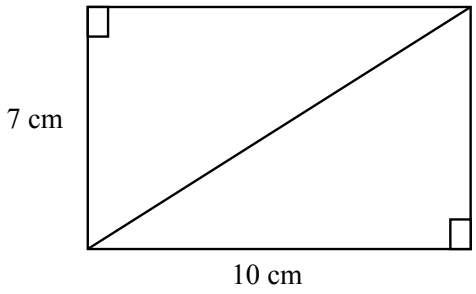
Split the class into four groups. Each student will have their own half sheet to fill out. Three of the sheets will have a different Pythagorean triple on grid paper and questions, while the other will not be a right triangle and will not work. After a few minutes to complete, ask students from each group to share out the relationship they have discovered.

Discuss: This is an informal proof that the Pythagorean Theorem works for any right triangle but does not work for other triangles.

Notes:

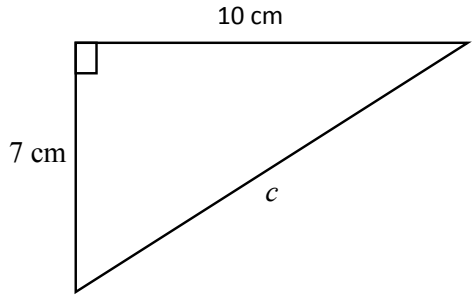
Example 1: We can use the Pythagorean Theorem $(leg_1)^2 + (leg_2)^2 = hypotenuse^2$ or $a^2 + b^2 = c^2$ to find the missing side of a right triangle.

Use your ruler to draw a rectangle to scale, that has legs of length 7 cm by 10 cm. Next draw a diagonal through the rectangle.



What two shapes do you now have?	[2 congruent right triangles]
Do you know all the lengths of the right triangle?	[No]
What is the missing side? a, b or c?	[c, the hypotenuse]

Draw the right triangle and label the sides.



Since we have a right triangle and one missing side, we can use the Pythagorean Theorem to find the hypotenuse. Round to the nearest tenth because we are finding a length.

$a^2 + b^2 = c^2$ where $a = 7$, $b = 10$ and c is unknown.

$$7^2 + 10^2 = c^2$$
$$49 + 100 = c^2$$
$$149 = c^2$$
$$\sqrt{149} = \sqrt{c^2}$$
$$c \approx 12.2$$

Take your ruler and measure the length to see how accurate we are.

You Try: Make a rectangle with dimensions 5 cm by 9 cm. Find the length of the diagonal of the rectangle. Round your answer to the nearest tenth and check the length by measuring with a ruler.

$a^2 + b^2 = c^2$ where $a = 5$, $b = 9$ and c is unknown.

$$5^2 + 9^2 = c^2$$
$$25 + 81 = c^2$$
$$106 = c^2$$
$$\sqrt{106} = \sqrt{c^2}$$
$$c \approx 10.3$$

Small Group Activity/Formative Assessment:

The converse of the Pythagorean Theorem states that a triangle has to be a right triangle if $a^2 + b^2 = c^2$ is true. In groups of three, you will be using measuring tapes to draw right triangles on the ground outside with chalk. Your group will decide the leg lengths of your right triangle and you'll use $a^2 + b^2 = c^2$ to find the hypotenuse. If your group finishes early, make your right triangle into a rectangle by constructing a congruent right triangle. Demonstrate inside.

Questions/prompts for students during outside activity:

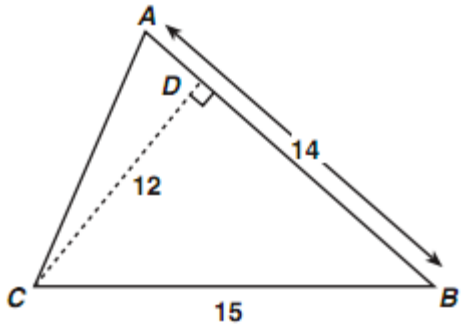
Did you start at zero on the tape measure?
(Many students struggle with measuring and will need review or individual help.)
What side lengths did you choose?
Show your steps with good syntax, equal signs lined up.
How did you find the hypotenuse?
Double check each measurement.
Who will be explaining your work to the other groups?
How will you explain this work to other groups?

Gallery Walk for Student Talk: One student stays with each triangle or rectangle, others rotate to see and discuss successful examples.

Extension/Homework: CST released item:

In this figure, $\overline{AB}$ and $\overline{CD}$ are perpendicular.

What is the perimeter of ΔABC?



Warm-Up

Name: _____

CST/CAHSEE:

If $x = 100$, what is the value of $3\sqrt{x}$?

A) 13

B) 30

C) 300

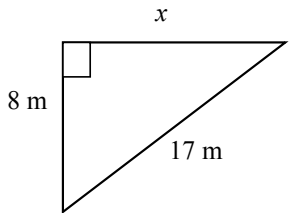
D) 310

- What possible mistake was made to get the other incorrect answers?

Review:

$\sqrt{40}$ is between which two integers on a number line? Explain to your math partner how you can tell.

Current:



What is the length of x?

A) 8 m

B) 15 m

C) 19 m

D) 25 m

- Use process of elimination and what you know about triangles to figure out the answer above. Explain your thinking.

Other:

Explain the difference between the answers to $\sqrt{100}$ and $x^2 = 100$.

Today's Objective/Standards: Know the Pythagorean Theorem and compute the length of an unknown side. **7MG 3.3**

Warm-Up

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CST/CAHSEE:

If $x = 100$, what is the value of $3\sqrt{x}$?

A) 13

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We are going to evaluate for x equals what number, class? [100]

$= 3\sqrt{100}$ — 100 is what number times itself? [10]

$= 3\sqrt{10 \bullet 10}$ — The square root of 10^2 is? [10]

$= 3 \bullet 10$

$= 30$

- What possible mistake was made to get the other incorrect answers?

A) added 10 & 3	B) multiplied 10 & 3	C) Put 3 & 10 together

Review:

$\sqrt{40}$ is between which two integers on a number line? Explain to your math partner how you can tell.

$\sqrt{40}$ is between 6 and 7 because $\sqrt{36} < \sqrt{40} < \sqrt{49}$ and simplified it's $6 < \sqrt{40} < 7$.

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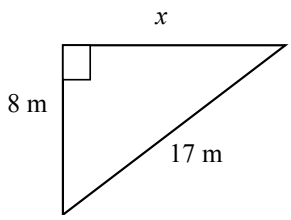

What is the length of x?

A) 8 m

B) 15 m

C) 19 m

D) 25 m

Since we are just beginning our study of the Pythagorean Theorem, you may have answered this by eliminating answer choices bigger than 17 since the longest side of a right triangle is the hypotenuse and it is 17 m. The other sides are called legs and they are not equal lengths, so it must be 15 m.

- Use process of elimination and what you know about triangles to figure out the answer above. Explain your thinking.

Other:

Explain the difference between the answers to $\sqrt{100}$ and $x^2 = 100$.

$\sqrt{100} = 10$, this is the principal square root, so you simplify it.

Whereas, $x^2 = 100$ is solving an equation.

$(10)(10) = 100$ and $(-10)(-10) = 100$, so $x = 10, -10$

For our lesson today, we will be using the principal square root to find the length of a side of a triangle because length is represented as a positive number.

Today's Objective/Standards: Know the Pythagorean Theorem and compute the length of an unknown side. **7MG 3.3**

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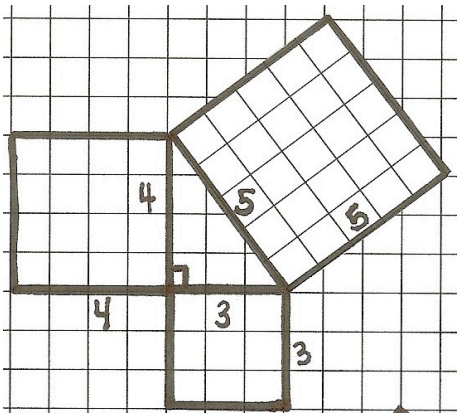

What are the lengths of the legs of the right triangle? _____

What is the length of the hypotenuse? _____

What are the areas of the squares off of the legs? _____

What is the sum of those two areas? _____

What is the area of the square off of the hypotenuse? _____

Explain the relationship between the sum of the areas off of the legs and area off of the hypotenuse?

_____

Do you think all right triangles will have lengths that are integers? Explain. _____

_____

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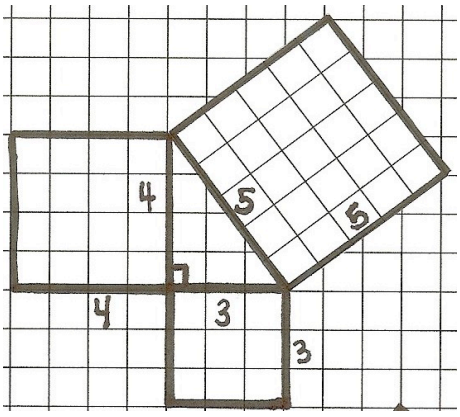

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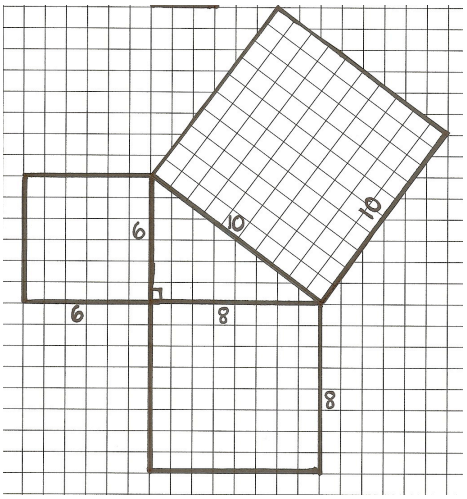

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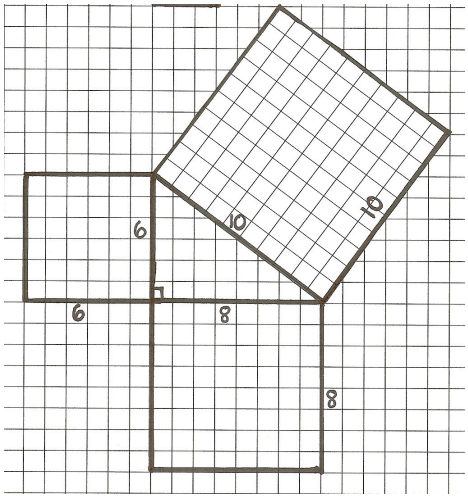

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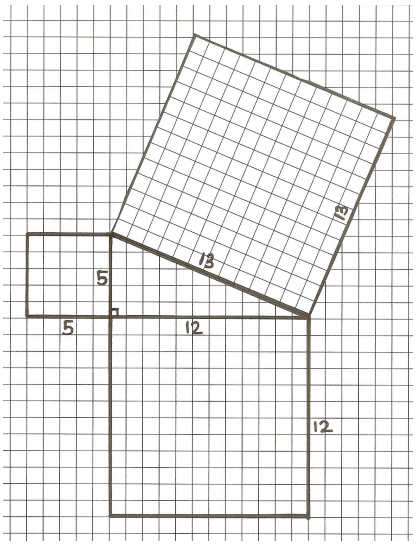

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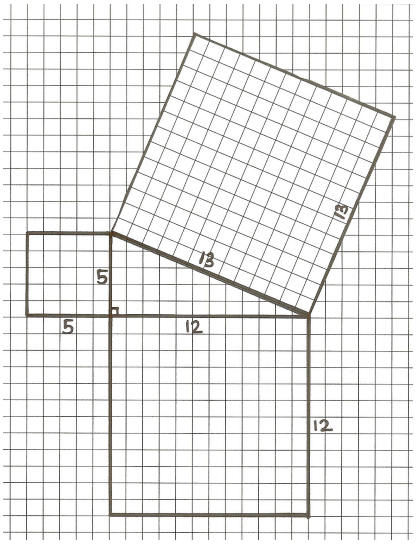

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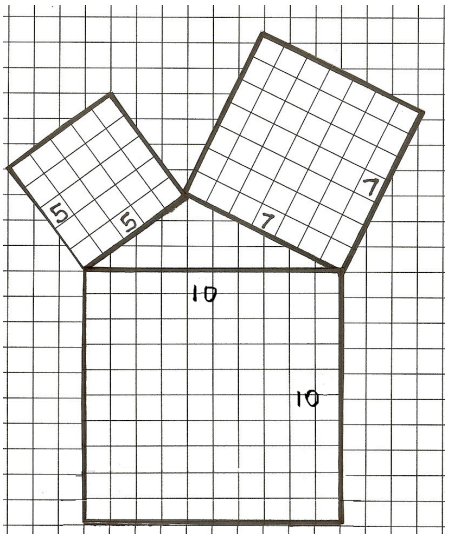

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What is the length of the longest side? _____

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What is the sum of those two areas? _____

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Explain the relationship between the sum of the areas off of the shorter sides and the area off of the longest side. _____

_____

If there is no relationship, why do you think that is? _____

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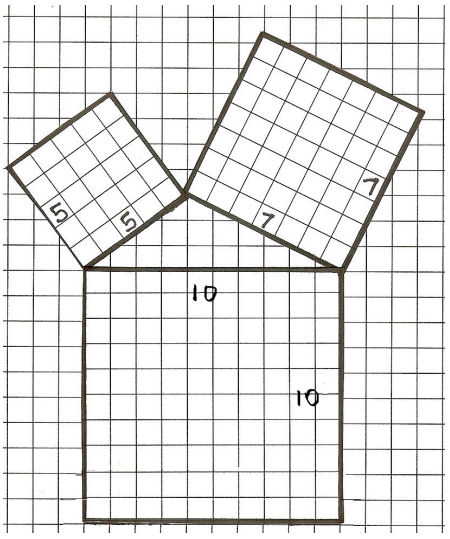

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