Welcome to Math with Mr. J. In this video I'm going to go through an introd uction to the Pythagorean theorem. Now the Pythagorean theorem has to do with right triangles and the relationship between the sides of right trian gles. It's called the Pythagorean theorem because it's named after Pythago ras, a Greek philosopher and mathematician. Let's jump into our examples and see... exactly what this all means and looks like. Starting with number one, where we have a right triangle. Now remember, the Pythagorean theo rem applies to only right triangles. Before we get started with the specifics of the Pythagorean theorem, we need to take a look at the sides of this tria ngle, and we are going to start with this side right here. The side directly ac ross from the right angle. This is called the hypotenuse. The hypotenuse is the longest side of a right triangle. And again, it will be across from or opp osite of the right angle. This is something we need to recognize and know when it comes to the Pythagorean theorem. Then we have the other two s horter sides. So this side right here and this side. right here. These are call ed the legs. So this is a leg and this is a leg. The Pythagorean theorem state s that the sum of the legs squared will equal the hypotenuse squared. So t he lengths of the legs squared add those together and that will equal the h ypotenuse squared. And that probably sounds confusing, worded like that. So let's write it out as an equation. plus b squared equals c squared. So for the Pythagorean theorem, we use that equation. Again, a squared plus b s quared equals c squared. Now, a, b and c all represent a side of the triangl e. Let's start with c. Now, c is always going to be the hypotenuse. So let's pu t a c here. And then a and b are going to be the legs. One. does not matter which leg is A and which is B. It will work out the same either way. So let's c all this A and this B. So what we are going to do, we are going to use the Py thagorean theorem, the equation A squared plus B squared equals C squar ed, to figure out the missing side length. This side, right here, the hypoten use. If we know two of the side lengths, we can... Then use the Pythagorea n theorem to figure out the missing side length. Let's plug in the informati on we know in order to figure out the information we don't know. So we ha ve both of the legs given a and b. So let's plug those in to the equation. So a squared plus b squared equals c squared. Again, we are given a and b. So let's plug those in. is 4 feet, so 4 feet squared plus b is 3 feet, so 3 feet squ ared equals c squared. Now we can work through this equation and solve f or c, so we need to figure out what c equals. Let's start with the left side of the equation, so 4 squared plus 3 squared. 4 squared means 4 times 4, so t hat gives us 16 plus 3 squared. That means three times three, that gives us nine equals C squared, 16 plus nine, that equals 25, equals C squared. Now we need to isolate that variable of C and get rid of the exponent of two. We do that by taking the square root. So let's take the square root of C square d. Now whatever we do to one side of the equation, we must... due to the

other. So let's take the square root of 25 as well. Now as far as the right sid e of the equation, the variable of C is now isolated. And then for the left sid e of the equation, the square root of 25 is 5. So C equals 5. Let's rewrite tha t with the variable first. So C equals 5. And this is feet. So that is out. missin g side length. This is 5 feet right here. We used the Pythagorean theorem t o figure out the missing side length of that triangle. Now let's take a look at a visual representation of number one and the Pythagorean theorem. This is going to help us better understand the Pythagorean theorem. For numb er one we had a right triangle with legs that measured 4 feet and 3 feet. th e hypotenuse measured five feet. So here is that right triangle. Let's find a, b, and c. We will start with the legs. This is a right here and this is b right he re. Remember, a and b are always going to be the legs and it doesn't matte r which leg is a and which leg is b. They are interchangeable. So keep that i n mind. And then we have the hypotenuse. which is always C. The hypoten use is the longest side, the side across from or opposite of the right angle. So this is C. Now let's take all of those sides of this triangle and square the m. And we're actually going to make a square on each side. This is A right h ere. So A, this is B. So B, and then this is C right here. So C. The areas of the two smaller squares, the legs, actually add up to the area of the large squa re, the hypotenuse. So the two smaller squares combined equal the large s quare. So the sum of the legs squared. So square those side lengths and a dd them together. And that sum is going to equal the hypotenuse squared . So that's side length squared. That's what the Pythagorean theorem state s. So let's square each side length to find the area of each square on the sid es of the triangle to show that this is true. For a, the area of that square is 1 6 square feet. For b, the area of that square is nine square feet. And then f or C, the area of that square is 25 square feet. So again, the areas of the tw o smaller squares, the legs, add up to the area of the large square, the hyp otenuse. 16 square feet plus 9 square feet equals 25 square feet. So A squa red plus B squared equals C squared. So it's pretty cool how that relates. w orks out for every right triangle. Now let's plug in A, B, and C into the equat ion to write it out that way as well. So we have A squared plus B squared eq uals C squared. Now we can plug in A, A, B, and C. So A is 4 feet, so 4 squar ed. B is 3 feet, so 3 squared plus C is 5 feet, so 5 squared. 4 squared is 16 p lus 3 squared is 9 plus 5 squared is 25. 16 plus 9 is 25. So 25 equals 25. No w obviously that's true. 25 does equal 25. So the relationship between the s ides holds true through that equation. We have the leg. represented on th e left side of the equation, a squared plus b squared. The sum of those legs squared was 25, and then the hypotenuse is represented on the right side of the equation. We have c squared. The hypotenuse squared was also 25. So there you have it. There is a visual representation of the Pythagorean th eorem. Now let's move on to number two. For number two we have a right

triangle with given side lengths of 15 centimeters and 17 centimeters. And then we have a missing side length. Now for this one, we have a leg given a nd the hypotenuse given. So let's call this a, this b. So this is the missing sid e length. And then this c. Remember c always has to be the hypotenuse. An d then a and b are the legs. It doesn't matter.  which leg is A and which is B. Now we can plug in what we are given into the equation A squared plus B s quared equals C squared and solve for the missing side length. So A square d plus B squared equals C squared. While we are given A 15 centimeters, s o 15 centimeters squared plus B squared, plus B squared plus B squared pl us B squared,  squared. We need to figure out what B is, so leave it as B sq uared. Equals C squared. Well C is 17 centimeters, so 17 centimeters squar ed. Now let's work through this equation and figure out what B equals. We will start with 15 squared. That means 15 times 15. That gives us 225 plus B squared E.  equals 17 squared, that means 17 times 17, that gives us 289. N ow we need to continue to work to isolate that variable. So let's subtract 22 5 from the left side of the equation. Whatever we do to one side of the equ ation, we must do to the other. So let's subtract 225 from this side of the e quation as well. The 225.  on the left side of the equation, cancel each other out, so we have b squared equals, and then on the right side of the equatio n, we have 289 minus 225. That equals 64. So we have b squared equals 64. We need to isolate that variable of b. Since we are squaring b, we have an e xponent of 2. So we need to take the square root.  root in order to isolate t hat B. Whatever we do to one side of the equation, we must do to the other , so we have the square root of 64 as well. The B is now isolated, equals an d then the square root of 64 is 8, so B equals 8 and this is centimeters. This is our missing side length. So B.  is 8 centimeters. So there you have it. Ther e's an introduction to the Pythagorean theorem. I hope that helped. Thank s so much for watching. Until next time, peace.