# Math-in-CTE Lesson Plan Template

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| Lesson Title: Squaring Corners | | Lesson # C12 |
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| Occupational Area: carpentry | | |
| CTE Concept(s): laying out 90-degree angles | | |
| Math Concepts: pythagorean theorem, 3-4-5 triangles | | |
| Lesson Objective: | Students will use the pythagorean theorem and 3-4-5 triangles to lay out square corners for construction | |
| Supplies Needed: | whiteboard, calculators, markers, pencil, paper, copy of worksheet for students, copy of answer key for worksheet, chalk lines, tape measure, (optional) "pythagorean puzzle" | |

| THE "7 ELEMENTS" | TEACHER NOTES (and answer key) |
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| **1. Introduce the CTE lesson.**<br>*This lesson is best as part of a building project where the students will need to lay out square corners.*<br>"We'll be laying out building lines today."<br>"We need to figure out a way to make sure we're laying out square 90-degree angles."<br>"We'll be laying out lines like this (different for each building project), and we'll need these lines to be squared to each other" | -On whiteboard sketch example of building layout. |

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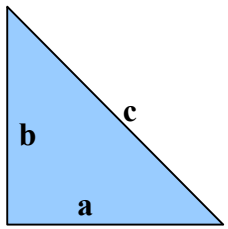
| **2. Assess students' math awareness as it relates to the CTE lesson.**<br>*this review/assessment can be given as an informal question session, or these questions could be printed on a handout.*<br>"A few quick review questions before we get started"<br>"What do we mean when we say lines are "square" ?"<br>"What's another name for a 90-degree angle?"<br>*Draw a right triangle on the board (clearly indicate the right angle)*<br>"What do you call a triangle with a 90-degree angle?"<br>"Can anyone tell me what $2^3$ is?"<br>"Has anybody heard of the pythagorean theorem? Can anyone explain it" | (answer, square means at 90-degrees, and/or perindicular)<br>(a right angle)<br>(a right triangle)<br>($2^3$ = 2x2x2 = 8)<br>write on board: $a^2 + b^2 = c^2$ - (for any right triangle, the length of the hypotenuse squared is equal to both of the other sides squared and added together.) |
| **3. Work through the math example *embedded* in the CTE lesson.**<br>*Put the theorem on the board. Label the right triangle according to the pythagorean theorem (a, b, and c).*<br><u>Pythagorean Puzzle</u><br>*Have "pythagorean puzzle" premade: 4 right triangles (labelled a, b, & c) that fit together to make a square. For example, from some plywood cut 4 triangles where **a** and **b** are both 12".*<br>*Use the triangles to demonstrate the Pythagorean theorem: Take two triangles and make a square with the **a** sides on the edge (**c** side is in the middle).* |  |

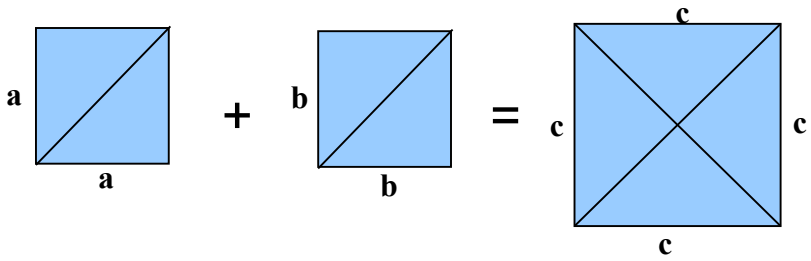
"We can take these triangles to make a square where the area is equal to **$a^2$.** Now we can take the other two triangles and make a square equal to **$b^2$**."

*Now, take the other two triangles and make a square with the **b** sides on the edge.*

*Then take all four triangles to make one large square (as shown on the right) with **c** on the edges.*

"So if we add them all together, the square will equal **$c^2$**."

"Do you see why it works? How adding **$a^2$** and **$b^2$** together we get **$c^2$**."




<u>3-4-5 Triangle</u>

"So now I'm going to give you an easy way to remember this. All you have to remember is 3, 4, 5. Lots of guys in the trade only know this method as "3, 4, 5."

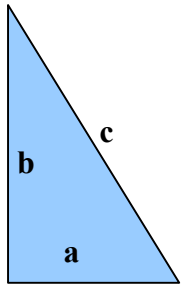
*Draw a 3-4-5 triangle on the board.*

"So if we have a right triangle, and this side is 3, and it can be 3 of anything (feet, inches, miles), and this other side is 4; then the hypotenuse is going to be 5."

"Let's check this with the Pythagorean theorem. If we take the square of the 3-side and add it to the square of the 4-side, we will get the square of the hypotenuse."

*Show them step-by-step by doing the Pythagorean-theorem equation to the right.*

*on board:*



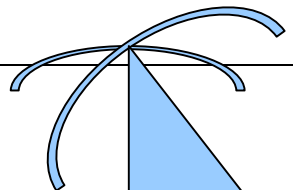

$3^2 = 3x3 = 9$

\+ $4^2 = 4x4 = 16$

$5^2 = 5x5 = 25$

*Go to an area where you have some open floor space with a straight edge/line alongside it (even 6' x 6' would do), snap a chalkline on the floor.*

*Ask* "Someone give me a number." *Have students suggest*



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| *numbers to you. Choose one number, for example 10.* "The edge along the chalkline will be 3, so we'll do 3-times-10, or 30" ." *On the line, mark a starting point and measure out 30" and mark that on the floor.*<br><br>*Go back to the starting point.* "Out from here we'll make the 4 side. 4x10 is 40" so we'll measure out 40. We're going to hold the end of the tape at our starting point. At 40" we'll swing an arc approximately 90-degrees from our chalk line."<br><br>"Now we'll go back to our 30" mark on the line, and we'll measure out the 5 side. 5x10 is 50", so we'll measure 50". Hold the end of the tape on the 30" mark on the chalkline, and we'll swing another arc at 50" so it intersects our arc at 40".<br><br>"Where the two arcs intersect, we'll snap a line connecting the intersection with our start point. And now we have a 90-degree angle. We can lay out anything we want from here." | |
| **4. Work through *related, contextual* math-in-CTE examples.**<br><br>"We can use this trick to lay out square corners for walls or footings, really anything we need to have a 90-degree angle."<br><br>"We can also use this to check that existing corners are square."<br><br>"If this length is 36" and this other length is 48", how should the length of the hypotenuse between them be?"<br><br>If the hypotenuse measures exactly, the corner is square. If the hypotenuse is longer or shorter than expected than the corner is more or less than 90-degrees (respectively). | Choose any inside corner that should be square. Along one wall measure out 36" (or any multiple of 3) from the corner and mark it. Now measure 48" along the other wall and mark it.<br><br>**60"** |
| **5. Traditional math-in-CTE examples**<br><br>*Back to whiteboard. Draw a 3-4-5 triangle on it. Give them the length of one of the sides and work with them to find the length of the other sides.*<br><br>*Label the bottom as 36".* "If the shorter side is 36", what is the | |

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| perpindicular-side going to be?"<br><br>"We can take the shorter side and divide by 3, since it's going to be the 3-side of the 3-4-5- triangle. This will give us the multiplier for the other sides of the 3-4-5 triangle."<br><br>"Since 36/3 is 12, we can do 12 times 4, and we get the length of the perpindicular side as 48".<br><br>"How about the hypotenuse?" | (perp. side is 48")<br><br>12 times 5 will give us the length of 60"<br><br>If students are having no problems, move on to the worksheet. If they seem to be a little confused during the example, do a few more on the board as a group. |
| **6. Students demonstrate their understanding.**<br><br>*Hand out worksheets, and have students work through the five problems on their own. After they finish go over each problem as a class, doing each one out on the board.* | |
| **7. Formal assessment.**<br><br>*Students will layout building lines on the shop floor using their tapes and a chalk line, as in the example in section 3.* | |