Math-in-CTE Lesson Plan Template

Lesson Title: Sheet Metal Squaring Exercise		Lesson # M13			
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Occupational Area: Sheet Metal/Welding Fabrication					
CTE Concept(s): Squaring Material					
Math Concepts: Customary Measurements : Ruler/Tape measure Geometry: Angles, Parallel & Perpendicular Lines, and Sum of interior angles.					
Lesson Objective:	Illustrate the importance of squaring material and proper sequence of cuts.				
Supplies Needed:	Ruler, tape measure, marker, Sheet Metal, Pen/pencil, Paper, Paper Cutter, Protractors, Right Triangles, and Sheet metal shear.				

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)		
1. Introduce the CTE lesson.	NOTE:		
Ask Students: "What's a 360?"	Do a brief overview of CTE Concept(s), Math Concept(s), and the Lesson Objective, from the information above.		
Have a Discussion:			
See if everyone in the class can give an example of what a 360 is. Typical responses include Skateboard, snowboard even bike tricks, and one may answer that a 360 is a circle.			
Teacher Response:			
"I'm hearing that a 360 is a circle, however it's actually a square and I'll show you later why."	<i>This is to hook your students interest</i> – DO NOT give them the answer "why?"		

2. Assess students' math awareness as it relates to the CTE lesson.	Hand out Math Awareness Worksheet, <i>which is attached to lesson plan.</i>		
Hand out Math Awareness Worksheet.	Have students do worksheet individually.		
1. What is a <u>Quadrilateral</u> ?	Once students have completed the worksheet discuss the answers to the questions, in order to assess their Math awareness. Definitions & Answers to worksheet: <u>Quadrilateral</u> – A polygon with four sides.		
2. What are some characteristics of the following shapes: <u>Square</u> , Rhombus . Rectangle , and Parallelogram ?			
3. How do you draw a right angle?			
4. How many degrees are in a right angle?	<u>Square</u> – All sides the same length. Each angle 90- degrees. Diagonals are congruent (same length).		
5. What are parallel lines?	<i>Rhombus</i> – a parallelogram with all four sides the same		
6. What are perpendicular lines?	length (congruent)		
7. Measure angles using a protractor?	<u><i>Rectangle</i></u> – quadrilateral with four right angles. The opposite sides of a rectangle are congruent (same length) and parallel. Diagonals are congruent (same length).		
NOW! Tell students why a 360 is a Square:	Parallelogram – a guadrilateral with both pairs of opposite		
Have a paper model of a circle within a square to give students a	sides parallel.		
that total 360.	<u><i>Right angles</i></u> – are angles that have a measure of 90- degrees.		
Flip the paper model over to illustrate the four 90-degree angles of a square, which also equals 360.			
This is why a 360 is a square.			
Make sure that students understand that the square drawn in the corners means a 90-degree angle. Half round means equal to (congruent). They should use appropriate symbols. Show students	(Draw on white board.)		
what they will see on an actual blueprint.	Parallel lines – lines that will never intersect (cross)		
	<i>Perpendicular lines</i> – two lines that intersect making a right angle.		
	May need to review how to use a protractor.		
	Measure (m) of Angle (\angle) 1 = 125° m \angle 2 = 90° m \angle 3 = 35°		

3. Work through the math example <i>embedded</i> in the CTE lesson.	Note: Previous lesson on shear safety and components.		
Give students a pre-cut paper shape and scissors .	Explain to students that the cutting edge is perpendicular to the fence <i>(90-degrees)</i> on the shear.		
squaring material using scissors.	Ask students to follow along with their paper shape, while		
Squaring Process:	Squaring Process:		
Cut, Flip, Cut, Rotate, and Cut	Step 1 - Pick an edge and label it "Fence" (this represents the side touching the fence)		
	Step 2 - Take your right triangle, put short edge on side marked fence with the 90-degree edge facing up.		
	Move right triangle as close to the top of material to maximize a full width cut. Draw a line and mark that line with "Cut".		
	Mark the 90-degree angle with appropriate symbol.		
	Step 3 - <u><i>Cut</i></u> excess material along line.		
	Step 4 - <i><u>Flip</u> previously cut edge down, assuring you keep fence on same side label "fence".</i>		
	Step 5 - (<i>Repeat Steps 2 & 3</i>) Make note of the relationship that the two cut sides (now parallel) are both perpendicular to the fence.		
	Step 6 - <u><i>Rotate</i></u> the non-squared side into the cut position (material is rotated 90-degrees toward fence)		
	Step 7 – (Repeat Steps 2 & 3)		
	Now you have a squared piece of material.		
	Measure the diagonals to confirm they are the same length. This test is an alternative form of assuring your material is square. (<i>Relate back to Geometry class that</i> <i>this was one of the tests to prove a square or</i> <i>rectangle.</i>)		

Note – Reinforce that the fence is 90 degrees (perpendicular) to cutting edge.			
Squaring Process:			
Cut, Flip, Cut, Rotate, and Cut			
1. Answer: 360 90 + 90 + 90 + 90 = 360			
Note: Other students may use the Sum of Interior angles formula. Formula: S = 180 (n - 2) S = Sum of interior angles, n = the number of angles, n = 4 S = 180 (4 - 2) S = 180 (2) S = 360			
 Answer: If consecutive sides are perpendicular or diagonals are congruent, then the parallelogram is a rectangle. In order to be a square all sides would also need to be congruent, while meeting the above requirements. 			

	3.	Answer: x = 8		
 In rectangle ABCD, AC and BD are diagonals. If AC = 2x + 5 and BD = 4x - 11, what is x? 		Steps:		
		Diagonals are congruent		
		AC = BD		
		2x + 5 = 4x - 11 -4x -4x	(Solve for <i>x</i> , combine like terms) (subtract 4x from both sides)	
		-2x + 5 = -11 - 5 -5	(Combine like terms) (subtract 5 from both sides)	
		$\frac{-2x}{-2} = \frac{-16}{-2}$	(Divide both sides by negative 2)	
A		x = 8	(remember negative/negative is positive)	
6. Students demonstrate their understanding.				
Give students one pre-cut metal shape.	Prior to this lesson instruct students how to properly use			
Students will use the squaring process, learned previously, but this time will be applied to Sheet Metal Shear .		the sheet metal shear!		
Students will be asked to label and mark their shape and confirm all cuts with teacher, prior to using sheet metal shear.				
Size of final product does not matter, as long as piece is square.				
7. Formal assessment.				
Students will cut required shape from existing stock material, to a pre- determined size of 6" x 6", utilizing the shear and fence ruler only.		al Assessment is ctor.	required to be performed with	
Demonstrating the squaring process to instructor.				

NOTES:

Math Awareness Worksheet:

Sheet Metal/Welding Fabrication - Squaring Material

1) What is a Quadrilateral?

2) Label the following: Square, Rhombus, Parallelogram or Rectangle



- 3) How many degrees in a Right Angle?
- 4) Draw a right angle.
- 5) What are Parallel lines?
- 6) What are Perpendicular lines?
- 7) Measure the following angles using a protractor.



Name: _____

Date: _____

Math Awareness Worksheet – Answers

- 1. Rectangle, Rhombus, Parallelogram, Square
- 2. 90-degrees
- 3. draw a right angle \perp
- 4. Parallel lines lines that will never intersect (cross)
- 5. Perpendicular lines two lines that intersect making a right angle.
- 6. 125, 90, 35