Highlighted Notes to Marc for completing lesson plan.

Math-in-CTE Lesson Plan Template

Lesson Title: What's Your Angle?		Lesson #
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Occupational Area: Machine Tool Technology		
CTE Concept(s): Blueprint Reading: Angles		
Math Concepts: Measurements of Angles, DMS		
Lesson Objective:	Students will recognize and understand the different angle components of a blueprint	
Supplies Needed:	Blueprint workbook (NAME), calculators (with DMS function), worksheets, various mach objects around the shop (must include angles)	

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
1. Introduce the CTE lesson.	
Up to this point, we have learned in the classroom to look at parts of various shapes. Today the lesson is going to be about recognizing and interpreting angles in a blueprint. Most of the angles we're going to talk about today are less than 90 degrees.	Students have already mastered blueprint reading, symbols for basic, "square" blueprints. The objective of this lesson is to extend to include angles. Present a "typical" straight blueprint Present a "tease" blueprint that includes angles.
Who knows what a 90 degree angle is called?	**Right ANGLE, symbol for right angle**
Hand out1 for reference:	
Top View (A) plain, all 90 degrees	
Front View (B) plain, all 90 degrees	
Right Side View (c) not all 90 degrees, notice angle that is	**Bevel: in math class, might be called slope**

45 degrees, this is also called a bevel. In math class **bevel** is sometimes called **slope.** Look around at the various objects on your work tables. We're going to make parts like this. They have angles. Pick one up; identify where the angles are. Where are you going to have to make an angled cut, called a **bevel**? When we are working with flat rectangular parts, the angles are pretty straightforward; remember they're called bevels. At some point, we'll also need to figure out angles for round parts, which are called **chamfers.** How do we measure angles? What if you have half a degree? Because we need to be so precise in the shop (three decimal places), we'll need to be equally accurate with angles. How accurate do we need to be in the shop when we specify angles? **<Note: find a "teaser" blueprint that is more complicated and includes multiple angles: maybe both bevel and chamfer>**	**Chamfer: in math class, we would talk about this when working with cones; it would be what math people would call** slant height In degrees Use fraction ½ or decimal .5 Always refer to the blueprint, but usually, +/- 1 degree
2. Assess students' math awareness as it relates to the CTE lesson. Worksheet2 : Given a blueprint, from our book identify and label all angles on the blueprint. Describe any angles that are equal. How do you recognize when you have a right angle on the blueprint? What is the geometry symbol for a right angle?	Blueprint book (name here), p._____. Teacher would project on whiteboard the print and have students label and identify angles. Remember that in the shop, lines on the blueprint are assumed to be **perpendicular** or **parallel.**

In math class, you may have learned different names for different size angles. We'll usually use angles less than 90 degrees. Anyone remember what those are called? (Draw an example on the board)	**Acute angles: angles less than 90 degrees** **Hint: Picture reindeer prancing singing "I'm cute! I'm cute!"**
Sometimes, you need to look at how the angle is related to other parts of the blueprint, like another angle, or triangle, because when we actually go to machine it, we may need that "other" angle. In math class, two angles that add to 90 degrees are called **complementary**. (Draw an example on the board)	**Complementary: two angles that add to 90 degrees.**
What about angles formed by two intersecting lines?	**Vertical Angles:** angles formed when two lines intersect. Also known as **opposite angles**.
While we're on the subject, what about angles that are bigger than 90 degrees? Anyone remember what those are called? (Draw an example on the board)	**Obtuse: angles that are bigger than 90 degrees and less than 180 degrees**
Sometimes we'll work with angles that combine to form a straight line. In math class, two angles that form a straight line are called **supplementary** angles. (Draw an example on the board)	**Supplementary Angles: angles that add to 180 degrees.**

3. Work through the math example *embedded* in the CTE lesson. Continue to use Worksheet 2 (Point to the angle in the upper left corner measuring 30 degrees. Sketch the completed triangle.) I find that when using blueprints, it helps to draw the triangle to help “see” the angles. Then you can use what you know about triangles to solve for the angles on the print. **<Talk about how you set up the part on the machine…..photo?>**	
How many degrees should I have inside a triangle?	Answer: 180 degrees.
Put examples on whiteboard of right triangles missing one angle. Work through one of them. Reinforce that the sum of other angles equals 90 degrees. So the two **acute** angles in the right triangle are also **complementary**, because they add to 90 degrees.	So if one of them is 90, then the other two need to add to 90, because that’s how many degrees I have left.
(use the same angle on Worksheet 2 that is marked as 30 degrees) What if this angle was 20 degrees? What would the other angle be?	Answer: 70 degrees
What if it was 17 degrees? What would the other angle be?	Answer: 73 degrees
What if it was 40 degrees? What would the other angle be?	Answer: 50 degrees
What if it were 25 ½ degrees? We’ll have to figure out what to do with fractional, or decimal angles a little later in this lesson?	Answer: 64 ½ degrees or 64.5 degrees

4. Work through *related, contextual* math-in-CTE examples. Worksheet 3 (includes same drawing, 3 different angles: 30 degree, one would be 40 ½ degrees, and one 50º15') I want you to draw in the right triangle for each of the specified angles. Then calculate the other angle. Remember, the two smaller or **acute** angles add to 90 degrees, making them **complementary**. We seeing more fractional or decimal angles now. Let's talk about how we deal with that in the shop. As you already know, we work with a level of precision in the shop that uses three decimal places. For angles, we've got to come up with a way to have that same level of precision. We do this using **DMS: degrees/minutes/seconds** Think about how many minutes are in one hour: 60 There are 60 **minutes** in one degree. Because we need more precision, we need to have fractions or parts of minutes. How many seconds are in one minutes? 60 Same with angles: there are 60 **seconds** in a **minute.** For example, on the worksheet you just finished, 40 ½ degrees would also equal 40 degrees, 30 minutes. Remember that ¼ of a minute is ¼ x 60 = 15 So ¼ degree equals 15 minutes. ½ degree equals 30 minutes. How many minutes for ¾ degree? Same for seconds, but we'll do that another time.	Worksheet should have same blueprint drawing as before, but angle is different, including a fractional angle (drive DMS discussion). Answer key here: 60 degrees 49 ½ degrees (talk about subtracting from 90) 39 degrees 45 minutes (first subtract the minutes from 60) Answer: 45 minutes

5. Work through *traditional math* examples. Worksheet 4 **<KNF will use math software to create this worksheet>** These are examples of problems you would find in regular math class, or on SAT or Accuplacer that are similar to the angle problems we've just been working on. Let me point out that the last one is a good example of cutting a hexagonal shape (six sides) from a square piece of stock. It won't be long before we're doing these kinds of things in the shop.	SAT questions that use inscribed and circumscribed circles and squares, extra credit for hexagon. NOTE: After struggle time, show students how to use DMS capability of their shop calculators. Answer Key: 90-38 degrees 40 minutes = 89 d 60 min-38 d 40 m 51d 20 m 90-70 ½ = 19 ½ translates to 19 d 30 m 60 degrees 60 degrees 30 degrees 90-45.25 = 44.75 translates to 44 d 45 m Remember that .25 degree = 15 minutes .5 degree = 30 minutes .75 degree = 45 minutes **<Put in hexagonal, complementary, supplementary, and vertical angle problems in here>**
6. Students demonstrate their understanding. <An 'in-between' blueprint that reinforces that they can "see" the angles in the print.	Build up to blueprints, either having students draw a blueprint for a part they are given or sketch from a part that involves angles.

7. Formal assessment. **<Go back to teaser blueprint from beginning of lesson and have them complete.>** **Extra Credit: the candle holders on your table have exactly 16 nails, equally spaced around a circle. How many degrees apart is each nail? Explain how you figured it out. Accuracy** **<Take a photo or bring in the nail candle holder>**	Have students work with the "tease" blueprint you started with. Have a simple one, a medium one, and an extra credit one that might lead to the next lesson/unit. Answer: 22.5 degrees, or 22 d 30m

NOTES: There are additional resources and worksheets that the team will scan, and create and then upload to the server to share. We were not able to accomplish this during the workshop. Thanks for your patience!