Math-in-CTE Lesson Plan

Lesson Title:	Stair Construction	*Lesson 01*
Occupational Area:	Construction Technology	
CTE Concept(s):	Stair Layout and Construction	
Math Concepts:	Measurement, Slope, Estimation, Tolerances	
Lesson Objective:	Layout and build a set of stairs given the constraint of the building project.	
Supplies Needed:	Projector (visualizer), transparencies of all worksheets Per student: blank stair terminology worksheet, Stair Layout Code Essentials, line handout, Stair Layout Worksheet, Job Site Stairs Worksheet	

THE "7 ELEMENTS"	**TEACHER NOTES (and answer key)**
1. Introduce the CTE lesson. Have you ever gone down a flight of stairs and felt like you were going to fall down? Or how many of you have gone up a flight of stairs and tripped? Do you know why that is? A lot of proper stair layout and construction has to do with a concept you are very familiar with from your math classes, slope, otherwise known as rise and run. We will be using that terminology rather than "slope" because that is the construction industry standard.	*Answer*: When you felt like you were falling, the risers were too short – the slope was too steep – or the treads were too small. When you tripped, either the risers were too tall or too short, because a normal stair is between 6" and 7 ¾".
2. Assess students' math awareness as it relates to the CTE lesson. Take out a sheet of paper and write about the following:	Free write to begin student engagement in the lesson and also use a formative

"Tell me what you know about rise and run or slope."	assessment to determine the collective knowledge base of the class as well as the prior knowledge of each student about slope (rise and run). Have the statement written on the board for the students to refer to as they write.
3. Work through the math example *embedded* in the CTE lesson. Use a standard stair layout template and put on the visualizer. Then, place on top a grid (like graph paper). Shine this on the white board and show the students how to calculate: o Unit rise o Unit run o Total rise o Number of risers and any adjustments to make to the unit rise figure o Number of treads and adjustments to make to the unit run figure Show the students how all of the code specifications apply to a standard stair layout template. Then, show a steep stair layout on the visualizer, putting the grid on top. Ask students to calculate: o Unit rise o Unit run Ask them to explain why these stairs would feel like you were falling down as in the introduction example. Use any references to code for the explanation.	First, students get a blank stair terminology sheet and fill it out with the correct code specifications. o One less tread than riser o Treads at least 11" o Riser height: 6" – 7¾ " o Minimum landing: 3'1" o Minimum headroom: 6'8" Students also receive "Stair Layout Code Essentials."

Do a third example using the stair layout that leads to the City of Aurora Municipal Building. (The rise is too low and the run is too long.) Again, ask the students to calculate: o Unit rise o Unit run Students will explain why these stairs are so hard to walk on using any references to code for the explanation.	
4. Work through *related, contextual* math-in-CTE examples. Remember when we studied roofing materials and talked about gables? Do you remember what we called the bottom part of the gable? To determine the slope of the roof, how much of the span would we need? Remember when we looked at the rise of the gable? We are going to look at these together for another slope or rise and run problem. I've used this term for the slope of the roof, but not recently. What do we call the slope of the roof? Take out your blueprints of the house and determine and calculate: o Rise o Run o Pitch of the roof (slope)	*Answer*: the span Gable = Triangle Span = goes all the way across the house *Answer:* 1/2 of the span would be equivalent to the run ½ span = run Rise = Rise to apex of the gable *Answer:* Pitch *Answers*: rise = 5"; run = 12", 5-12 pitch

5. Work through *traditional math* examples. Project a sheet with five different lines on it of varying slopes. Place the same transparency grid on the top. Give students a handout of the same. Put students in small groups of 2-3 and assign them one of the slopes to calculate. Remember that when you look at these lines, each line could be called the stringer on a set of stairs. It is all the same. Have students show how they determined the rise and run of their line to the whole class.	Students receive handout See worksheet example.
6. Students demonstrate their understanding. Using 7" as your average riser height, calculate the number of risers first that you would need. Remember that you cannot have a part of a riser, like 3 ½ risers. Let's do example #1. Pay close attention to the way I make my decisions about how many risers to use in my stair layout. Example #1: 70 ½" total rise ÷ 7 = 10.07 risers. Since you cannot have 0.07 risers, you could have 10, or maybe 9 risers would work better. Even 11 risers might be the best. So now what we need to calculate is: 70 ½" ÷ 9 = 7.83 (unit rise) 70 ½" ÷ 10 = 7.05 (unit rise)	Students receive the Stair Layout Worksheet. Use 7 because 7" is average riser height. Do first example on Stair Layout Worksheet.

70 ½" ÷ 11 = 6.41 (unit rise) Only two fit in the parameters of a 6" to 7 ¾": you can either have 10 or 11 risers. You would chose 10 risers because it results in a closer average riser height of 7" and is one less riser for cost of materials than using 11 risers. If needed, 10 risers could also help with headroom height because 10 risers would create a slightly steeper slope, making for more headroom.	Students complete the worksheet.
7. Formal assessment. Students go out to the job site, conduct the measurements, and fill out the Job Site Stairs Worksheet. In approximately two days from this lesson, the students will build a set of stairs for the job site based on agreed-upon measurements.	See Job Site Stairs Worksheet. (Answers vary based upon job site.)

NOTES: