



# Connecting Industry to Mathematics Instruction

NSF ATE Award # 1954291

## Steel Consequences

### *A Discover Understanding Task*

**Purpose:** To compare, analyze, and interpret steel fabrication and erection data in verbal, tabular, graphical, and algebraic forms.

**Career Field:** Construction Project Management

**Company:** SteelFab

#### **WTCC Associate Program of Study and Contact Person:**

Civil Engineering Technology and Geomatics

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#### **NC Math 4 Standards:**

**AF.1 Apply properties of function composition to build new functions from existing functions.**

- **AF.1.1** Execute algebraic procedures to compose two functions.
- **AF.1.2** Execute a procedure to determine the value of a composite function at a given value when the functions are in algebraic, graphical, or tabular representations.

#### **Unit Alignment:**

NC Math 4 - Functions Unit Lessons 5 or 6

MAT 121 - Unit 1: Functions

#### **Common Core State Standards for Mathematical Practice**

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.
9. Use strategies and procedures flexibly.
10. Reflect on mistakes and misconceptions.

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PUBLIC SCHOOL SYSTEM



## Prerequisite Skills

- Excel skills
- Creating equations from data
- Analyzing and interpreting data

## Time Required

The time required to complete this activity is approximately 90 minutes with some work such as the Desmos activities, discussion and brainstorming questions being completed or visited outside of class.

## Materials Needed

- [Desmos Activity](#)
- [Student Activity Sheet](#)
- SteelFab Activity [Google Sheets](#) Spreadsheet
- [Activity Answer Key](#)

## The Teaching Cycle:

**Launch:** Students may complete the Desmos Launch Activity in class in small groups of 2-4 or individually at home.. To maximize class time for the Student Activity, the Desmos Launch Activity may be completed for homework prior to the start of the Student Activity. Ask students to identify any unknown vocabulary introduced in the Launch video and Student Activity introduction. Clarify the goal of the activity and the vocabulary.

The Launch video will explain that SteelFab is a steel fabrication and erection company. At SteelFab fabricators cut, fit, weld, galvanize, and paint steel at a fabrication plant to create the pieces of frame structures for buildings. Next, the pieces are transported to the worksite where erectors assemble the pieces by welding or bolting them together.

Teacher will serve as a facilitator in this activity. Students will work in small groups of 2-4 to complete this activity. Distribute the Student Activity sheet. Allow time for students to read the activity and have a brief discussion in their groups about their understanding of the activity. Be prepared to answer questions regarding Excel and industry terminology.

## Explore:

This activity builds on itself. It is necessary for students to have the correct formulas and values in each Phase in order for them to proceed with the activity. Encourage discussion about why errors occur and the different ways students arrive at their answers.

### **Phase 1**

[Task a] Depending on the Excel skill level of you and your students, students may need to write out the formula in words or an equation first. Students must create an Excel formula for the Fab Duration. It is hoped that after the Desmos activity students will be able to create their own Excel formula. If not, guide them to the Excel formula. Students will need to enter the formula and fill the column. This task may require scaffolding or will need to be checked by the teacher before students proceed with the activity if assigned outside of class. Ask students to consider how the units on each piece of information help us decide how to set up the formula.

[Task b] Make sure the students understand that the next sequence cannot begin until the previous one has finished. You might ask questions like... Can Sequence 2 start before 1 is finished? How does the Fab duration relate to the Fab start?

[Task c] Make sure the students understand that the Fab Finish is an ongoing total. You might ask questions like... Why can't the finish day value be less than the duration value? How do the Fab start, duration, and finish relate to each other?

## **Phase 2**

[Task a] This question should lead to a discussion about the meaning of the parts of the graph- the axes, points of intersection, the legend, etc.

[Task b] Guide them to think about how the order in which the work is completed at the plant and the jobsite matters. You might ask questions like... Can this part of the job start before the other? Can a lego scale replica be built without first having the legos?

[Task c] Remind students about the previous discussion. You might ask questions like... How long does it take to complete Seq. 1? Can erection take place while Seq. 1 is being fabricated? Encourage students to share how they got their answer from the graph or the table.

[Task d] Remind students about the previous discussion. You might ask questions like... What is happening when the lines intersect? What does the saying "Time is money" mean? How does it pertain to this situation?

## **Phase 3**

[Task a] Have the students brainstorm any circumstances that could hinder progress with the fabrication or erection processes. If students struggle to think of ideas, ask them what could cause workers to be unable to do the following: clean, cut, galvanize, or paint the steel at the plant; transport the steel to the worksite; layout, lift, or weld the pieces at the worksite.

[Task b] Make sure that students do not alter the Fabrication Table. Only the erection will be affected. Fabrication will continue as scheduled. You might ask questions like... Will Fabrication, Erection, or both be affected by the illness? How?

[Task c] Ask students to refer to their discussion and response to Phase 2b above.

To find the needed Erection Start date, students must find the value in D16 that places the Fabrication (blue) line below the Erection (orange) line with 5 days between fabrication and erection Start dates for Seq. 8. Students should use trial and error and look for trends as they change the value. This would be your optimal schedule with little room for any type of disaster.

[Task d] Remind students that you must find how the first day of erection for the Seq. 1 relates to the fabrication schedule. Encourage students to investigate and mark the graph and the table. We found the erection start date to be day 23, lead students to see on the graph where the erection start lines up vertically with the fabrication start.

We can also identify from the table the number of sequences with a Fab finish less than 23.

[Task e] Encourage students to investigate and mark the graph and the table. You could ask questions

like... Where is the end of the project on the graph? Where is the end of the project on the table?

[Task f] You could ask questions like... How will the storm affect the project end time? How many days will the storm delay the project?

#### **Phase 4**

[Task a] Students will change cell E4 and fill the column. This will change other cells throughout the spreadsheet so that students can see how the number of days will decrease.

[Task b] Change Seq. 1 Fab start to 7. Encourage students to share how they got their answer from the graph or the table.

[Task c] You could ask questions like... How do you know when a sequence is complete? How many sequences will be completed in 30 days or less? How many pieces are needed for each sequence? What is the total number of pieces needed for the project?

[Task d] You could ask questions like ... How do you calculate total pay? How many days will it take to complete fabrication for the first 6 sequences? What is overtime?

#### **Discuss:**

The discussion should connect to the notation of composite functions. Students should be led to recognize that they used the output of a function as the input of another function to find answers.

- How do each of the columns of the fabrication table relate to each other?
- How are the fabrication and erection related?

#### **Exit Ticket:**

1. What did you learn about SteelFab?
2. What did you learn about Wake Tech's Applied Engineering and Technologies programs?
3. Explain how each of the columns of the erection table relate to each other? Express the relation in words and with an equation.