

Sara B. Jacks

Ormond Beach Middle School, Ormond Beach, Fl, 32174

## Summary

Although technology is an integral part of our daily lives, its integration into the classroom has yet to be fully realized as “there is little consensus about the way in which programing should be included in the curriculum” (Moreno-León, Robles, & Román-González, 2016). While cutting edge technology and computer programing basics are still finding their way into our classrooms researchers state that students are better equipped to transfer the information they learn in school to daily life when problems faced in daily life are integrated to the classroom (Sen & Güler, 2017).

A hands-on way to introduce students to technology would be through integration of 3D printers into classrooms as 3D printing is revolutionizing all sectors of science, technology, engineering, and math (STEM) (Hughes et al., 2017). Research shows this implementation of 3D printing in classrooms to be impactful as “students involved in them marvel at the physical products they can produce from their own designs” (Lacey, 2010). Projects involving 3D printing also “teach students process used in today’s industry for product design and manufacturing” (Lacey, 2010), while maintaining enough adaptivity for differentiation based on student need. This seems like an ideal way to “make students see the big picture by making connection(s) among ideas and revealing the relationships that exist among concepts” which according to Ojose “teachers should avoid teaching mathematics concepts/topics in isolation” as this negatively impacts students understanding on concepts such as ratios and proportional reasoning (Ojose, 2015).

## Research Activities

### Synthesis Of Carbon Nano Tubes using Chemical Vapor Deposition



### 3D printing using CAD generated models



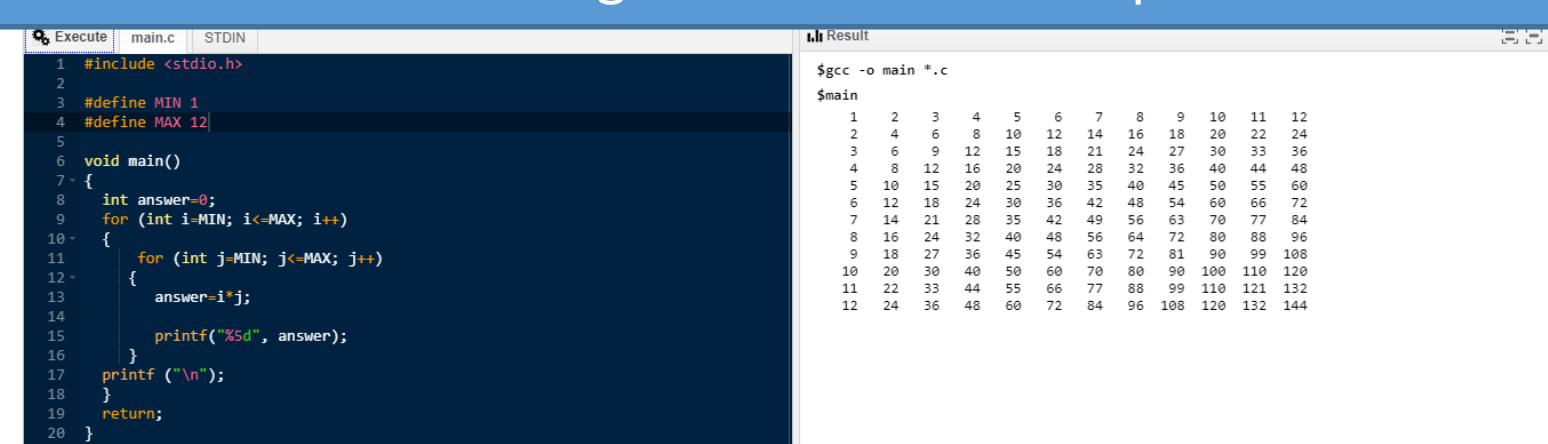
### Making of Bucky paper using Pressure Filtration



### Manufacture of Carbon Fiber Plate



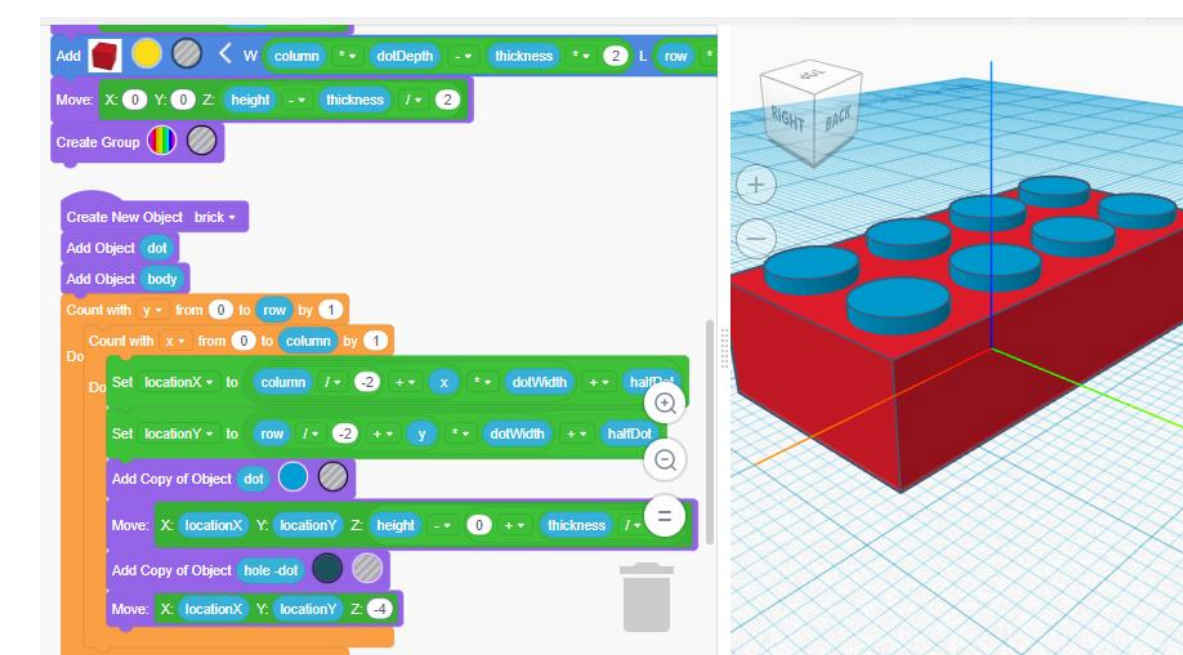
### Times table generate with C compiler



## Lesson Plan

### Background

Prior to this lesson students will be participating in a STEM Wednesdays, where the class will explore and develop a basic understanding of applications of STEM. Students will be introduced to coding and design process. Students will also be introduced to codeblocks on tinkercad. A user-friendly introduction into how coding works. Students will use this program to develop their own designs, with the cumulating product being the 3d printed item they have designed themselves.



(Snip of tinkercad code blocks) – visual program

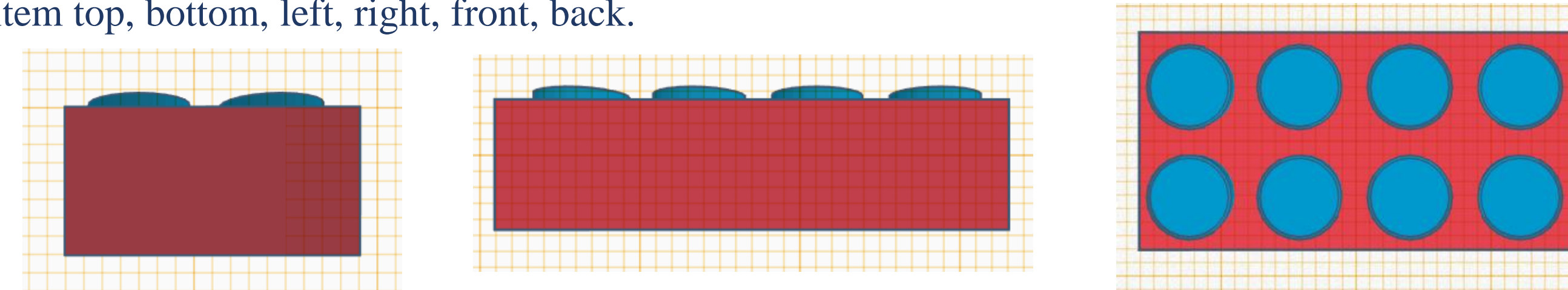
The lesson you see below is a subset of this STEM Wednesdays focusing on scale factor, and unit conversion.

### Day 1

Students will be provided a handout in which they will be asked to sketch their CAD modeled item in “actual size”, I will model this process and walk them through what this should look like.

After about 10-15 mins, I will model appropriate measuring and labeling techniques. I will circulate the room and provide additional guidance where needed.

As students complete their measurement portion of this activity I will instruct them to transfer what they see in the tinkercad program onto the 1mm<sup>2</sup> grid paper, they will do this from each view of their item top, bottom, left, right, front, back.



### Day 2/3

I will then explain to students that this illustration is the actual size their item will print, I will then facilitate a discussion targeting the questions:

Is this the size you wanted your item to print?

-What do you think happened?

Does this match the size you see on the computer?

-Why do you think this is?

What happens when you zoom in and out?

How can we get our code blocks items to print the size we want?

I will provide guidance and leading questions to assist students in their process of solving their scale issue through unit conversion.

Students will complete their conversions, input these new values into their tinkercad code blocks program.

### Day 4

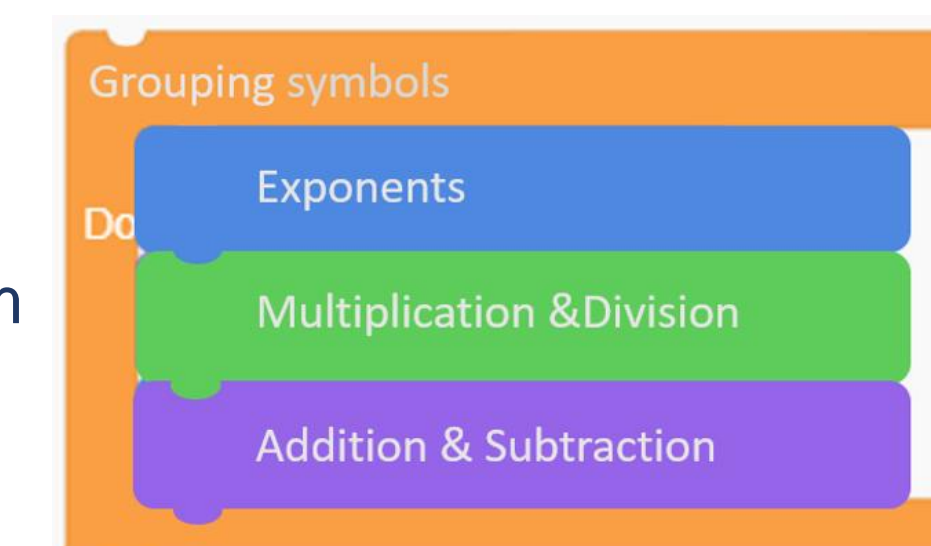
Students will then be asked to once again transfer what they see in the tinkercad program onto the 1mm<sup>2</sup> grid paper, they will do this from each view of their item top, bottom, left, right, front, back.

Students will be asked to compare this with their ideal size. If this does not suite their ideal size I will prompt students to trouble shoot and provide necessary supports as they make adjustments.

### Other Connections Middle School Math Content

Students will also build connections with the process involved in computer programming to other concepts with in Mathematics for example:

- Recognizing for loop's as repetitive process similar to order of operations.
- Making connections between the binary number system and standard scientific notation in base 10.



## Lesson Learned and Assumptions

-Students will have previously worked with the tinkercad program and developed their own 3D designs within this program.

-This lesson will be used at the end of the ratio and proportional reasoning unit.

-This activity will assist students in building connections between proportional reasoning and scale drawings/ scale factor.

## Learning Objectives

-Students will recognize the purpose of a scale factor and explain how the zoom function in technology a function of a scale factor is .

-Students will be able to apply proportional reasoning to compute scale conversions.

-Students will utilize unit conversions to visualize the actual size of a resulting item generated from a CAD program.

Possible change: “Students will recognize the purpose of a scale factor and explain how the zoom function in technology is a function of a scale factor”

Change to “Students will utilize” just for continuity of the section.

## Misconceptions students may have:

- Students may believe the item they have designed will automatically print out the desired size.
- Students may not understand the difference between units of measure. (cm v. mm)
- Students may not know the difference between length width and height.
- Students may attempt to make unit conversions on only one dimension such as height.
- Students may not realize the significance of defining variables u

## Implementation Strategy

- Guided Inquiry
- Cooperative Learning
- Mathematical Reasoning
- Mathematical Modeling
- Error Analysis

## Trouble Shooting Tips

-Students may need assistance in adding “work plane” in various views so they can see the grid from each view in tinkercad.

-Be sure students are using the mm<sup>2</sup> blocks when transposing onto the secondary document.

-Students with limited experience in tinkercad code blocks may need assistance in inputting their new values for length, width, and height. To prevent this, the teacher may provide a specific item to students generated in code blocks and provide an outline for this

## Acknowledgments

RET Site: COMET Program, College of Engineering and Computer Science, University of Central Florida. This content was developed under National Science Foundation grant EEC-1611019.

## References

(Lacey, G. (2010). Get students excited--3D printing brings designs to life. *Tech Directions*, 70(2), 17-19.

Moreno-León, J., Robles, G., & Román-González, M. (2016). Code to learn: Where does it belong in the K-12 curriculum? *Journal of Information Technology Education: Research*, 15, 283-303

Ojose, B. (2015). Proportional reasoning and related concepts: Analysis of gaps and understandings of middle grade students. *Universal Journal of Educational Research*, 3(2), 104-112. 10.13189/ujer.2015.030206

Sen, C., & Güler, G. (2017). Effect of strategy teaching for the solution of ratio problems on students' proportional reasoning skills. *Malaysian Online Journal of Educational Sciences*, 5(2), 1-15.

Sinnott, S. B., & Andrews, R. (2001). Carbon nanotubes: Synthesis, properties, and applications. *Critical Reviews in Solid State and Materials Sciences*, 26(3), 145-249. 10.1080/20014091104189