

**Phase 1: Research and Planning**

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CURR 676: The E in STEM: Meaningful Content for Engineering

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**Possible Activities**

When thinking about having students build a structure, there are a variety of projects that students could complete. They could build a tower using spaghetti and marshmallows while focusing primarily on structure height without having to support a marshmallow on top. They could also focus on 3D shapes by using toothpicks and gumdrops to build structures made of shapes. The activity that stood out to me was having students build a tower using spaghetti and tape which had to support a large marshmallow. This allowed students to think about math standards and shapes, as well as considering science concepts such as weight/support and gravity.

**Best Activity for my Classroom**

The activity that I chose is “Spaghetti Anyone? Building with Pasta” from NASA’s Jet Propulsion Laboratory. In this activity, students are given 40 strands of uncooked spaghetti, unlimited tape, and one big marshmallow. Their goal was to work with their group to build the tallest structure in 20 minutes that could support a marshmallow. I felt that this activity was best for my classroom because it was an activity that lent itself easily to collaboration and the engineering design process. The students also get excited every time they get to handle food, so I knew that they would be invested from the get-go. As a bonus, this activity required supplies that were either already in the classroom or easily accessible.

**“Big” Concept**

The “big” concept I wanted to cover in this engineering design challenge was considering external factors, such as mass and gravity, while building. Students need to consider load-bearing members, compression, and bending when designing their towers. The materials working together will need to have an equal amount of strength, tension, and compression to support the

mass. This also ties into math concepts with 3D shapes and structure. As with all engineering design challenges, this project focused on collaboration and reflection as students worked together and modified their project.

### **Standards**

This activity covers standards across multiple subjects. The subjects and standards covered in this project are Engineering Design, Science, and Math.

#### ***Engineering Design***

- MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- K-2-ETS1-3: Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
- 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

#### ***Science***

- 2-PS1-3: Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

#### ***Math***

- CCSS.MATH.CONTENT.2.G.A.1: Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.1 Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

### **Problem Solving, Declarative Knowledge, Procedural Knowledge**

The two problem solving methods present in this activity are:

1. Problem solving results in behavior that leads to a solution

2. Problem solving is a process that involves manipulation of or operations on previous knowledge.

The students are presented with a problem, plan a solution, and implement that solution to solve the problem/task. In the 20 minutes given to them, students keep testing and building on their idea to improve it. Eventually, they have a solution that meets the parameters of the problem.

They also use previous knowledge about shapes to build a sturdy structure. The groups should be able to manipulate their understanding of 3D shapes to build a tall tower that can support the weight of a marshmallow.

The declarative knowledge that students need about this project are the principles of the properties they are manipulating. For example, if they put too much weight on a strand of spaghetti, then it will bend and possibly snap. They need to have an understanding of the materials and their properties in order to use them successfully in this design. When it comes to procedural knowledge, this is an ill structured problem. There can be multiple correct solutions when designing and building the structure. There is no one right answer, and all of the correct answers may not look similar.

### **Objectives**

- Students will be able to apply their knowledge of 3D shapes to build a stable structure
- Students will be able to design a structure that can support a mass
- Students will be able to analyze and critique their projects in order to make improvements
- Students will be able to create a structure through planning and collaboration
- Students will be able to revise their idea and model based on experiment results
- Students will be able to assess their projects and draw conclusions about its effectiveness