LESSON PLAN

The Marshmallow Challenge

An introduction to Engineering and Teamwork

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SUBJECTS

Science

GRADES

3 – 8

OBJECTIVES

Students will be able to...

- Understand the importance of teamwork and failure in science and engineering
- Understand that some shapes are stronger than others
- Understand that even weak materials can be made stronger with good design techniques, and that distribution of mass is an important consideration when building a tower
- Understand that compression and tension affect the stability of a structure
- Compare their model to others to understand why some models are stronger than others
- Understand why engineers consider tension and compression forces when designing a building or structure

1 THE CHALLENGE

Haiku Deck

Using Haiku Deck, create a presentation that includes the following:

The CHALLENGE:

Build the tallest free-standing structure in just 18 minutes using no more than 20 sticks of spaghetti, one yard of tape, one yard of string, and one marshmallow. The marshmallow must be on top and cannot be deformed to hold it in place. The structure

has to stand firmly on its own; it cannot be propped up, held, or suspended from the ceiling.

2 THE RULES

Haiku Deck

Go over and Display the following rules:

The RULES

✦Build the Tallest Freestanding Structure: The winning team is the one that has the tallest structure measured from the tabletop surface to the top of the marshmallow. That means the structure cannot be suspended from a higher structure, like a chair, ceiling, or chandelier.
✦The Entire Marshmallow Must Be On Top: The entire marshmallow needs to be on the top of the structure. Cutting or eating part of the marshmallow disqualifies the team.
✦Use as Much or as Little of the Kit: Team can use as many or as few of the 20 spaghetti sticks, as much or as little of the string or tape.The team cannot use the paper bag as part of its structure.
✦Break up the Spaghetti, String or Tape: Teams are free to break the spaghetti and to cut up the tape and string to create new structures.
✦The Challenge Lasts 18 minutes: Teams cannot hold on to the structure when the time runs out. Those touching or supporting the structure at the end of the exercise will be disqualified.

Ensure Everyone Understands the Rules: Don't worry about repeating the rules too many times. Repeat them at least three times. Ask if anyone has any questions before starting.

3 START THE CHALLENGE

Timers4Me - Timer & Stopwatch

Free, Paid

Start the countdown clock and the music with the start of the challenge.

✦Walk around the Room: It's amazing to see the development of the structures as well as notice the patterns of innovation most teams follow.

✦Remind Teams of the Time: Count down the time. Typically, the leader calls the time at12 minutes, 9 minutes (half-way through), 7 minutes, 5 minutes, 3 minutes, 2 minutes, 1 minute, 30 seconds and a ten-second countdown.

✦Call Out How Teams Are Doing: Let the entire group know how teams are progressing. Call out each time a team builds a standing structure. Build a friendly rivalry. Encourage people to look around. Don't be afraid to raise the energy and the stakes.

✦Remind Teams that Holding their Structures will Disqualify Them: Several teams will have a powerful desire to hold onto their structure at the end — usually because the marshmallow, just installed at the apex, is causing it to buckle. The winning structure must be stable.

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4 FINISH THE CHALLENGE

Activity:
Conversing

After the clock runs out, ask everyone to sit down so they can see the structures. Just over half the teams are likely to have standing structures.

✦Measure the Structures: Measure from the shortest standing structure to the tallest and call out the heights. Have someone record the heights.

✦Identify the Winning Team: Ensure they get a standing ovation and a prize (if you've offered one).

✦Wrap up with the Lessons of the Marshmallow Challenge: Describe some of the key lessons of the marshmallow challenge. Discuss:

What building techniques make the tower stronger?
Does the placing of the marshmallows affect the strength of the tower?
Could you build a stronger tower with more of the same materials? What alternative materials would be better?

Does the size of the base alter the strength of the tower?
How do you think you worked as a group? Did you assume different roles? Did all groups work in the same way?

5 WRAP UP

Ted-Ed

Tom Wujec shares findings from the Marshmallow Challenge in a 2010 TED Talk "How to Build a Power Team."

http://www.ted.com/talks/view/lang/en//id/837

Some findings:

- Kids do Better than Business Students: On virtually every measure of innovation, kindergarteners create taller and more interesting structures.
- Prototyping Matters: The reason kids do better than business school students is kids spend more time playing and prototyping. They naturally start with the marshmallow and stick in the sticks. The Business School students spend a vast amount of time planning, then executing on the plan, with almost no time to fix the design once they put the marshmallow on top.

The Marshmallow is a Metaphor for the Hidden Assumptions of a Project: The assumption in the Marshmallow Challenge is that marshmallows are light and fluffy and easily supported by the spaghetti sticks.

When you actually try to build the structure, the marshmallows don't seem so light. The lesson in the marshmallow challenge is that we need to identify the assumptions in our project – the real customer needs, the cost of the product, the duration of the service – and test them early and often. That's the mechanism that leads to effective innovation.

6 TROUBLESHOOTING

Activity:
Other — Troubleshooting

Generally, a tight presentation introducing the challenge will motivate teams. Let

them know this challenge has been conducted by tens of thousands of people in every continent, from top CFOs to students at all levels. The lessons learned are universal.

- Goals & Rules: Be very clear about the goals and rules of the challenge. Generally, you'll want to repeat them three times and reinforce them visually.
- Cheating: In almost every challenge, there is at least one team that will want to cheat or bend the rules in their favor. The clearer you are about the rules the better the results.
- Prizes: Offer a prize to the winning team. A standing ovation from the rest of the group is great. Books, software, perk. But be wary of big prizes as you'll read in the Lessons of the Challenge.
- Music: Select the appropriate music for the challenge. Wujec prefers driving Rock or Pop, but dramatic classical works well too.

Be clear about the goals and rules of the Marshmallow Challenge:

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- Ensure Everyone Understands the Rules: Don't worry about repeating the rules too many times. Repeat them at least three times. Ask if anyone has any questions before starting.