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## STEM Challenge - Multi Day 80 min

### Objective:

I can work together with a team to design and construct a successful tower.

I can identify the differences between an architect and an engineer.

I can explain the limitations that impact the building of a tower.

I can problem solve and research to find answers to difficult questions with my team.

I can solve challenging math problems.

### Big Idea:

Collaborative teams will work through a series of difficult math and reading challenges that will lead them to an engineering task to problem solve together.

This activity should be spread out over several days or work periods.

## 1. Warm Up / Anticipatory 60 min

STEM Challenge:

1. Students will work in small groups to answer the math questions provided. The answers to the problems get them to #1443, 1722 and 1737.

2. Students will then use these numbers to access the Wonders of the Day at Wonderopolis.com.

#1443 Where is the Tallest Building? <http://wonderopolis.org/wonder/where-is-the-tallest-building>

#1722 How are Buildings Built? <http://wonderopolis.org/wonder/how-are-buildings-built>

#1737 What's the Difference Between an Architect and an Engineer?  
<http://wonderopolis.org/wonder/whats-the-difference-between-an-architect-and-an-engineer>

3. Answer specific questions to get the supplies for the Tower Challenge.

4. Challenge – Build the tallest free-standing tower using only pipe cleaners.

- Use up to 15 pipecleaners
- No other materials

- No propping up with chairs, tables etc.
- Height will be measured from the base to the end of the tallest pipe cleaner.

5. Day 2 of challenge:

New Rules - due to budget cuts, your construction company had to reduce the number of workers. All students must work with one hand behind their backs. Work together, but only use one hand each.

After 5 minutes of 1 handed work time, announce that the construction company realized that more workers will be needed to meet the deadline, but these workers don't speak English. Continue working without speaking due to the language barrier.

## 2. Investigation and New Learning

**Envelope #1 - a Math problem with an answer of 1443.**

X is a number with:

6 in the thousands place

5 in the tens place

2 in the ones place

5 in the ten-thousands place

2 in the hundreds place

Y is a number with:

9 in the ones place

8 in the hundreds place

5 in the ten-thousands place

4 in the thousands place

0 in the tens place

The solution is the difference between X and Y.

**Envelope #2 - a multi-step math problem with an answer of 1737.**

R is a number that

has 3 digits

is divisible by 5 but not 10

has the same number for all 3 digits

S is a number that

has 4 digits

is divisible by 2 and 3

has a prime number in the ones place

has a composite number in the tens place that is twice the value of the number of digits

has the same number in the hundreds place and thousands place

the number in the hundreds and thousands place is not a prime or composite number

The solution is the sum of R and S.

### **Envelope #3 - a multi-step math problem with an answer of 1722.**

N is a number

with 2 digits

with a tens digit twice the value of the ones digit

with a ones digit that is the smallest prime number

B is a number

with 2 digits

with a tens digit 4 times the value of the ones digit

with a ones digit that is not a prime or composite number

The solutions is the product of  $N \times B$ .

**Envelope #4 - Use the website [www.wonderopolis.org](http://www.wonderopolis.org) and the answers to the math problems you solved. Answer the following questions correctly in order to receive your next envelope. Some answers will be found through reading and others will be found through viewing. Your team must work together to determine the answers.**

A. What are limitations that keep buildings from going as high as a mile or more?

Answer: Wind, Money, Elevators (1443)

B. What animals are climbing on the outside of the gingerbread house built by four construction workers?

Answer: Gummy Bears (1737 in the video)

C. Draw a t-chart and place the following characteristics with the correct job title of Architect or Engineer.

Answer: (1737)

1) Concerned with the appearance of the building Architect

2) Concerned with the function of the building Engineer

3) Concerned with the materials used Engineer

4) Concerned with the safety Engineer

5) Concentrate on artistic creativity Architect

6) Concentrate on scientific innovation Engineer

7) In college, takes more art classes Architect

8) In college, takes more technology classes Engineer

D. How many men climb from one moving platform to another in the Building Beijing construction video?

Answer: One (1722 video)

E. What is the first step in building?

Answer: A blueprint (1722)

F. Name two cities in the United States who have had the world's tallest building in the past.

Answer: Chicago, New York (1443)

G. What is the general rule about foundations when it comes to tall buildings?

Answer: The taller the building the deeper its foundation must be (1722)

**Envelope #5 - Using what you now know about architects, engineers and building projects, use these 15 pipe cleaners and no other materials, to plan and then build the tallest free standing tower. It must stand unsupported for 30 seconds before being measured from the base to the highest point. You will have limitations imposed on you during your work time so be ready to problem solve and work together!**

Envelope #6 - LIMITATION ALERT - you must now select only two people per group to touch the pipe cleaners. They will need to do what the group directs them to do.

Envelope #7 - LIMITATION ALERT - everyone can come back to work, but now there is no talking allowed. If a group member speaks, a pipe cleaner will be take away from your supply.

Envelope #8 - LIMITATION ALERT - you have only 3 minutes remaining. You may speak and all members can touch the pipe cleaners. Your tower will be measured at the end of 3 minutes.

### 3. Review & Check for Understanding 30 min

Follow Up Discussion:

What worked well?

What did you do when things got difficult or challenging?

What did you learn about engineering?

Explain how you used the Engineering process.

What did you learn about problem solving with a team?

What will you do differently next time we do a challenge?

**Note:** Teacher will need to set up teams and prepare envelopes of clues prior to starting the challenge. Groups will need 15 pipe cleaners for their tower