STEAM Math Lesson:

Structure Building Challenge - Grades 6-8

This lesson will allow students to design and build their own structure using spaghetti and marshmallows, focusing on concepts of tension and compression, and calculating ratios using measurement and division skills. This activity encourages critical thinking and collaboration, too!

✅	✅	✅
Teacher Led	**Requires Computer OR Mobile Device**	**Requires Spaces**

Spaces Prep	**Create your Activity in Spaces before the lesson. Not sure how to create an Activity? Check out this short video tutorial on assigning and managing activities.**

Learning Goals

1. Students will **build** a structure using provided materials.
2. Students will **calculate** their tower's load bearing ratio using measurement and division skills.
3. Students will **reflect** on their design choices based on outcomes.

Materials

Student Handouts	• **Handout [A] - The Logistics** for each pair or group (page 5) • **Handout [B] - Design Reflection** for each pair or group (page 6)
Technology Requirements	• Mobile device, tablet, or laptop • Projector or Smartboard
Video/Audio Clips	• Leaning Tower of Pasta demonstration video from TeachEngineering
Additional Materials	• 20 pieces of dry spaghetti (for each pair or group) • 30 mini marshmallows (for each pair or group) • Pencils • Scale • Measuring tape or ruler • Flat pieces of cardboard (one for each pair or group) • Small weights or objects like erasers, blocks, etc.

Instructions

Before the lesson

1. Start by explaining the activity and its purpose: students will work in pairs or groups to build the strongest structure they can using only dry spaghetti and mini marshmallows. Their goal is to build the strongest freestanding structure in a given time period, and they will calculate their structure's load-bearing ratio capacity at the end.

2. Show the Leaning Tower of Pasta demonstration video from TeachEngineering, stopping to discuss the following terms and concepts (you may want to have these written on the board and record definitions/notes as a class as you go):
    - Tension: applying a force to something to stretch it (pushing/pulling something apart)
    - Compression: applying a force to something to compress it (pushing/pulling something together)
    - Ratio: the relation between two amounts showing the number of times one number contains another number
        - Depending on your students' conceptual understanding of ratio, you may want to discuss real-life examples of this as a group– for example, the

ratio of kids with a pet at home vs. no pets at home, the ratio of students to teachers in the room, etc.

During the lesson

1. Put students into groups of 2-4, and give each group the following materials:
    - 20 pieces of dry spaghetti
        - Give spaghetti to students unbroken, but they are allowed to break pieces into different lengths once they start building
    - 30 mini marshmallows

2. Once all pairs/groups have their building materials, give students 2-5 minutes to discuss their design together– encourage them to think through how to negotiate tension and compression best to build the strongest possible structure. Remind them that their structure must be freestanding.

3. After a short discussion, give students 15-20 minutes to build their structure. All groups should have the exact same amount of time.
    - A best practice is to set a timer that students can see on the board; once it goes off, all hands off of materials.
    - Have students do a gallery walk and/or take a picture of each students' structure before the next step.

4. Once building time is over, have each pair/group get the following materials:
    - Measuring tape or ruler
    - Scale (or give each pair/group access to a scale to use)
    - Flat piece of cardboard, or other material to be used as a flat surface
    - Aa handful of small weights or objects of the same weight (erasers, blocks, etc.)
    - **Handout [A] - The Logistics** (page 5)

5. Have each pair/group measure and record their structure's height and weight, the weight of the flat surface, the weight of their structure + the weight of the flat surface, and the weight of one of their objects (rows 1-5 on **Handout [A] - The Logistics** (page 5))

6. Then, have students put the flat surface on top of their structure and their weights or objects, one at a time, on top of the flat surface. Pause after putting each one on to ensure the structure stays upright. Have them continue loading objects until their

structure collapses, then make sure they record the total number of objects their structure held BEFORE it collapsed (row 5 on **Handout [A] - The Logistics** (page 5)).

7. Next, have students calculate the total weight of the objects that their structure held (for example, 3 grams x 12 objects) in row 6 of **Handout [A] - The Logistics** (page 5).

8. Finally, have each pair/group calculate their structure's load bearing ratio by dividing the total weight of objects held (row 6 of **Handout [A] - The Logistics** (page 5)) by their structure weight + weight of flat surface (row 4 of **Handout [A] - The Logistics** (page 5)) in row 7 of **Handout [A] - The Logistics** (page 5).

After the lesson

1. As a class, discuss what worked well and what didn't work as well in the design choices of different groups.
2. Have students complete the design reflection **Handout [B] - Design Reflection** (page 6).

Worksheet

HANDOUT [A]: The Logistics

Names _____

After you build and before and during measurement, record the following logistics about your structure design:

Structure Height	
Structure Weight	
Weight of Flat Surface	
Structure Weight + Weight of Flat Surface	
Weight of Each Object & Number of Objects Successfully Held	
Total Weight of Objects Held	
Load Bearing Ratio (Structure Weight + Weight of Flat Surface / Total Weight of Objects Held)	

Worksheet

HANDOUT [B]: Design Reflection

Names _____

After building your design, testing its load bearing capacity, and calculating its load bearing ratio, reflect on your design choices below.

1. What worked well in your design (try to be specific in terms of tension and compression)?

2. What didn't work as well in your design (try to be specific in terms of tension and compression)?

3. If you were to redesign your structure, what would you change to increase its load-bearing capacity and ratio?