STEM at HOME

SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH

PRESENTED BY: girlstart

Parthenon Architecture

Architecture and geometry collide as you learn how columns are used to build gigantic buildings like the Greek Parthenon. Conduct two experiments that demonstrate how simple paper columns can work together to support the weight of books… and even humans!

**We recommend that you do this activity after "Greek Columns"*

TEKS:

SCI 1.6 B: The student is expected to distinguish between attributes that define a two-dimensional or three-dimensional figure and attributes that do not define the shape.

MATH 3.6 A: The student is expected to classify and sort two- and three-dimensional figures, including cones, cylinders, spheres, triangular and rectangular prisms, and cubes, based on attributes using formal geometric language.

SCI 4.6 D: The student is expected to design a descriptive investigation to explore the effect of force on an object such as a push or a pull, gravity, friction, or magnetism.

SCI 5.6 D: The student is expected to design a simple experimental investigation that tests the effect of force on an object.

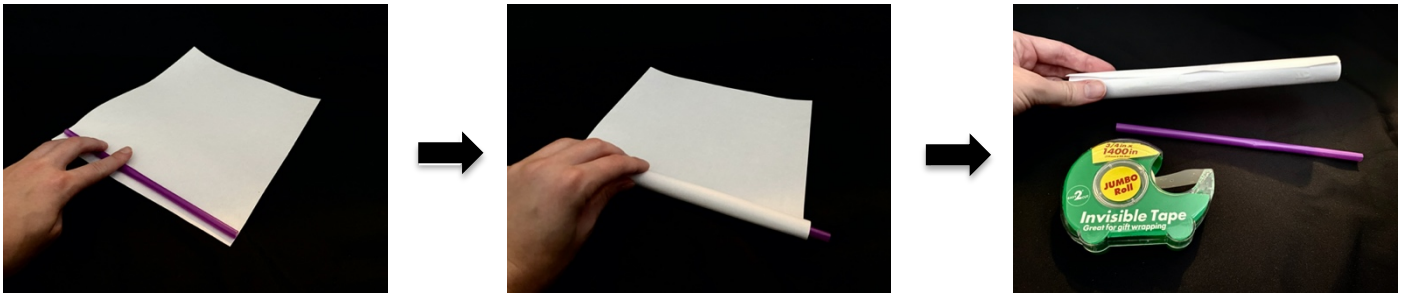
Materials:

- 2-4 books
- 2 cookie sheets or sturdy pieces of cardboard (large enough to stand on)
- 12 paper cups
- 12 pieces of copy paper (or more!)
- Straw or dowel
- Tape

Experiment/How To:

Part 1 – Build a sturdy structure.

1. Place a straw or dowel at the short end of a sheet of copy paper and roll the paper around the straw.
2. Tape the paper so that it stays rolled and pull it off of the straw. This represents one column!
3. Repeat steps 1 and 2 to make 12 columns in total.



4. Tape the 12 columns together into the shape of a cube (see photo below for guidance).

5. Is the cube structure that you just made very stable? Place books one by one on top of your paper cube structure. How much weight can it hold?
6. What other shapes can you make from your paper columns? Re-arrange them into a different structure and test how many books your new shape can hold. Or, add more paper columns to your cube structure and see how tall you can make it!

Part 2 – Paper cup challenges!
**We recommend that you have someone stand next to you as you complete all of these challenges, just in case you lose your balance!*

1. Challenge #1: Place one paper cup face down on the ground in front of you. *Carefully* try and balance on top of this single paper cup.
    - What happened? Unless you have the balancing skills of a professional tightrope walker, the cup was most likely immediately crushed under your feet.
2. Challenge #2: Place 6-12 cups face down, evenly spaced beneath a cookie sheet (or a piece of cardboard). As carefully as possible, try and balance on top of this cookie sheet.
    - What happened this time? It might have been easier to balance on the paper cups! If you still could not balance, add a few more paper cups beneath the cookie sheet and try again.
3. Challenge #3: Place 6 more cups face down, evenly spaced on top of your first cookie sheet. Then, add a second cookie sheet on top of this second layer of cups. As carefully as possible, try and balance on top of this second cookie sheet!
    - Could you balance on this two-story paper cup tower?

STEM Connection:

How were lightweight sheets of copy paper able to hold the weight of multiple books? And how were simple paper cups able to support the weight of a human? The answer lies in the paper's shape and quantity!

You turned two-dimensional rectangular copy paper into three-dimensional cylindrical columns. Cylinder-shaped columns are capable of supporting lots of weight on their own, as you found in the Greek Columns activity. Furthermore, you used *multiple* cylindrical columns to build *one* structure. All of these columns worked together to support the weight of many books!

A similar thing happened in the paper cup challenge. Most likely, when you stood on top of just one paper cup, it crushed under your weight immediately. This is because all of your weight was pushing down on just one cup! However, after adding a few cups and placing a cookie sheet on top of all of them, they were probably able to support your weight. Using multiple cups with a cookie sheet on top causes your weight to be spread across all of the paper cups, so no single cup is supporting too much weight. You might notice that, when buildings contain columns in their structure, they often have more than one column!

The Ancient Greeks recognized the structural power of columns and used them in many of their building designs. The Parthenon is a giant temple in Greece that is dedicated to the goddess Athena. It sits at the very top of the Acropolis, a hill in Athens covered in ancient temples, statues, and buildings. The Acropolis was an important place to the ancient Greeks–they went there to pray, shop, and see plays–and the Parthenon was the most important building of them all. Guess how many columns were part of the Parthenon? 85!

Career:

Architectural engineers apply technology, engineering, and math principles to building design and construction. They make sure structures are appealing while also combining all functions a building needs like structure, mechanics, lighting, electricity, acoustics, and safety.

Resources:

http://preschoolpowolpackets.blogspot.com/2016/09/ancient-greek-architecture-stem.html
https://www.science-sparks.com/how-can-you-stand-on-a-paper-cup-without-breaking-it/
https://teachbesideme.com/make-paper-hold-up-books/