



Heart Cup Stacking

Can you build a heart out of just cups and cardboard? Channel your inner structural engineer and get a hands-on introduction to balanced forces.

TEKS:

SCI 4.6 D: The student is expected to design an experiment to test 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 an experiment that tests the effect of force on an object.

SCI 6.8 B: The student is expected to identify and describe the changes in position, direction, and speed of an object when acted upon by unbalanced forces.

SCI 6.11 B: The student is expected to understand that gravity is the force that governs the motion of our solar system.

Materials:

- Cardboard
- 21 disposable cups (red cups work best)
- Scissors

STEM Challenge:

Stack 21 cups into the shape of a heart! Here are your guidelines:

- You must start with only one cup on the first level of the structure.
- The only other material that you can use is cardboard (and scissors to cut the cardboard).
- Good luck!

If you need help, check out the "How To" section on the next page.

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How To:

1. Cut the cardboard into four rectangles. For 16oz plastic disposable cups, each rectangle should be approximately 4 inches wide and have the following increasing lengths: 8 inches, 12 inches, 16 inches, and 20 inches.
 - a. If you are using a different size cup, each rectangle's width should be a bit wider than the top diameter of a cup. The length of the first rectangle should be a bit longer than 2X the top diameter of a cup, the second rectangle 3X the top diameter, etc.
2. Begin by placing one cup face-down on a flat surface.
3. Place the smallest cardboard rectangle centered on top of this cup.
4. Add two face-down cups to the top of this cardboard rectangle.
5. Repeat with the next three pieces of cardboard and 12 additional cups. At that point, you should have a cup stack with a row of five cups on the top!
6. Add four cups face-down on top of these five cups (no cardboard needed now) and then two more cups on top of those to act as the top of your heart.



STEM Explanation:

How many tries did it take before you successfully made a heart out of just cups and cardboard? Did you find it tricky to build the heart without the cups crashing down? That's because your structure required all of the forces in the heart to be balanced! A force is simply a push or pull, and one force that acts on everything all of the time is gravity. The force of gravity pulls objects toward the earth, including the cups and cardboard in this STEM challenge! The very first cup that you added to the structure represented your heart's center of gravity. Each time that you added a new cup or piece of cardboard to the heart, gravity acted on that new cup to pull the entire structure to the ground. However, if the force of gravity was equal on both sides of the first cup, the forces in the structure were balanced, causing the structure to remain standing. Just like the forces were balanced in your heart structure, structural engineers use balanced forces when they design all types of buildings so they withstand forces like gravity, compression, wind, and more!

Career Connection:

Structural engineers design and construct bridges, buildings, dams, tunnels, power plants, offshore drilling platforms, and space satellites. They research the forces that will affect the structure, and then develop a design that allows it to withstand these forces.

Resources:

<https://littlebinsforlittlehands.com/valentines-day-stem-activities-challenges-kids/>

<https://www.generationgenius.com/balanced-and-unbalanced-forces-for-kids/>

<https://spaceplace.nasa.gov/what-is-gravity/en/>

<https://steemit.com/stemng/@churchboy/the-role-of-balanced-forces-in-structural-design>

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