Elementary Trades and ADST Projects at Home

Project: Bridge building challenge

Time required: ½ hour to 1 hour

Theme: ADST, STEM, and engineering careers

This activity can be used to explore engineering and introduce concepts involved with bridge building. This lesson was modified from https://www.sciencebuddies.org/stem-activities/bridge-building-designs and can also be used as a lead up to the Skills Canada spaghetti bridge challenge http://skillsbc.ca/PDF2015Regionals/Spaghetti%20Bridge%202015.pdf.

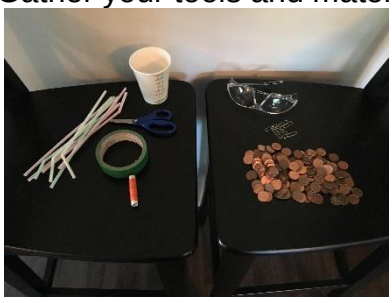
Grades: K-3 as an adult demonstration, 4 to 7 with adult supervision and assistance

Tools and Materials:

- 7 to 10-Drinking straws
- 1-Paper cup
- Masking tape
- Thread or fishing line
- 4-Paper clips (2 large preferred)
- Coins (approximately 300 pennies or 150 quarters) or similar materials to act as weights such as small rocks
- 2-Chairs or tables of similar height
- Scissors
- Tape measure
- Safety glasses (recommended throughout build and testing)

Procedure:

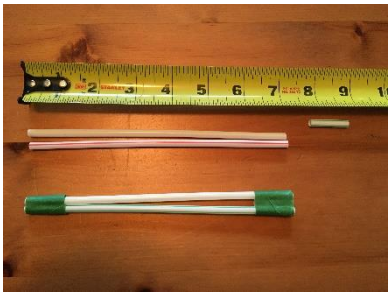
1. Gather your tools and materials.



2. Prepare your two bridge towers by gathering 4 to 5 straws. We used bendable straws and found that two straws per tower worked fine. Ensure the bendable portion of each straw is cut off with scissors and you are left with four long

portions of equal length. Also, cut two short 1” segments either from the leftover bendable portion or from a fifth straight straw.

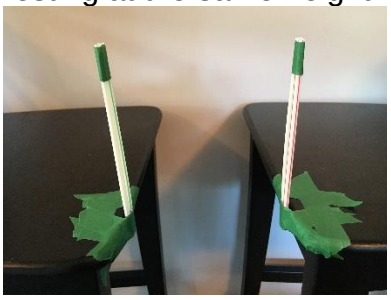
3. Next, assemble your <u>bridge towers</u> by taping one short piece of straw near the end of one long piece.

Finish one bridge tower by taping a second long straw to the other side of the short piece to create a long triangle.

4. Repeat step three to create a second bridge tower.

5. Assemble your bridge by taping each tower to your chair or table so they are resting at the same height with short sandwiched straw at the base.



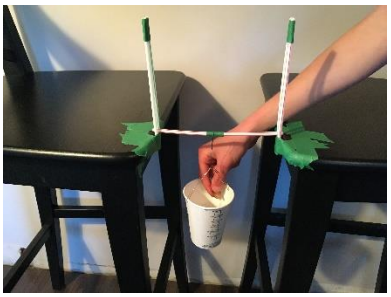
Space your towers only as far as one straw length. After cutting off our bendable portion we were left with roughly 7 inches of straw, so we spaced our chairs slightly under 7 inches.

6. Add a bridge deck to your towers, to create a beam bridge, by placing a length of straw to fit between your towers while resting on each short straw. The center of your deck straw can be measured and marked with tape for later testing.


7. Build a load tester with your paper cup by first carefully poking two holes near the top opening of your cup. The holes should be directly across from each other and can be made simply by poking an opened paper clip through. Make sure your fingers are clear and ask for an adult to help if needed. Finish your load tester by straightening a paper clip to act as a hanger for your cup. This hanger should be shaped like a V, with a hook at each end, and will hook into the holes in the top of your cup. We used two smaller paper clips for this step.

Another paper clip can now be added to your hanger by unbending a paper clip so there is a hook at each end. This will allow you to hang your load tester while testing.

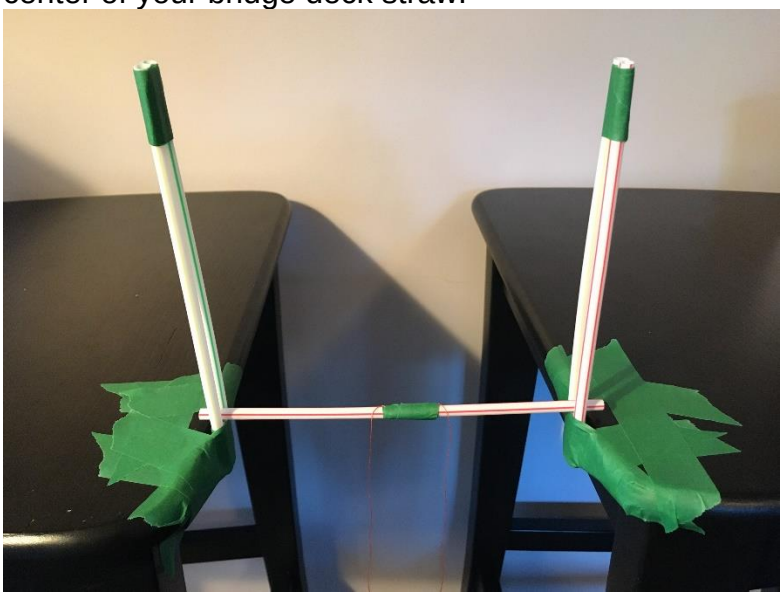
8. Begin testing your beam bridge by hanging your load tester at the center point of your bridge deck. Add coins, one at a time and watch for signs of stress.



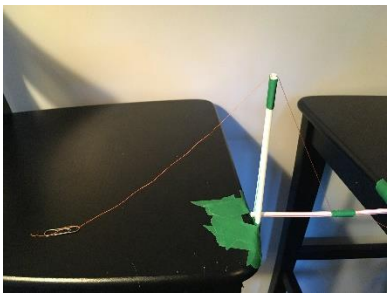
Recognize how your bridge fails and count how many coins your bridge was able to hold before collapse.

9. Now improve your bridge design by creating a <u>suspension bridge</u>. Start by replacing your bridge deck straw with a new straight straw segment and suspend between towers as before.

10. Next, cut three feet of thread and tie or tape the center of your thread to the center of your bridge deck straw.



Now tie a paper clip to each end of your string and hang over the top of your towers. Finish your suspension bridge by pulling your paper clips and string over your towers away from the center of your bridge until fairly tight and secure with tape to your furniture.




11. Begin the testing procedure, by hanging your load tester and adding coins until your bridge fails. Again, recognize how the bridge fails and count the number of coins you were able to add. You are sure to be amazed!


How your suspension bridge works:

When the beam bridge failed, this was likely because the bridge deck straw bent downward as more coins were added until it bent so much that it slipped down between the two towers. As coins were added to the suspension bridge, the cable (i.e., thread) was under tension and reinforced the bridge deck straw, pulling it upwards (while compressing the towers) and allowing the bridge to hold more coins. When the suspension bridge eventually failed, the bridge deck straw likely similarly bent into a V-shape, but because it was attached by the thread, the straw could not fall and instead the cup may have slipped off of the straw. https://www.sciencebuddies.org/stem-activities/bridge-building-designs

Extensions:

- Experiment with changes to your design after additional research; https://bridgemastersinc.com/breaking-down-essential-parts-of-a-bridges-structure/, https://en.wikipedia.org/wiki/Suspension_bridge. Try to improve the performance of your bridge by securing the deck to the towers or adding structural elements to your design.
- Research careers in engineering at https://newengineer.com/insight/8-of-the-most-in-demand-engineering-jobs-for-2020-1126177 or https://typesofengineeringdegrees.org/highest-paid-engineering-jobs/ to start planning an engineering career.

Assessment:

Discussion questions and challenges:

1. Why did your suspension bridge likely perform better than your beam bridge?
2. How could you change the design of your beam bridge to improve its performance?
3. How could you change the design of your suspension bridge to improve its performance?
4. Name some of the elements of bridge design and how they work.
5. What are some local or international examples of suspension bridge technology at work?
6. What type of engineer designs bridges?

Discuss these questions and visit; https://bridgemastersinc.com/breaking-down-essential-parts-of-a-bridges-structure/ or https://en.wikipedia.org/wiki/Suspension_bridge to explore the relevant concepts involved in this activity.

Research careers in engineering at https://newengineer.com/insight/8-of-the-most-in-demand-engineering-jobs-for-2020-1126177 or https://typesofengineeringdegrees.org/highest-paid-engineering-jobs/.

Visit https://curriculum.gov.bc.ca/curriculum/adst to make connections with ADST curriculum.

Resources and Links:

https://www.sciencebuddies.org/stem-activities/bridge-building-designs (bridge building lesson)

http://skillsbc.ca/PDF2015Regionals/Spaghetti%20Bridge%202015.pdf (spaghetti bridge challenge)

https://bridgemastersinc.com/breaking-down-essential-parts-of-a-bridges-structure/ (bridge engineering and design)

https://en.wikipedia.org/wiki/Suspension_bridge (suspension bridge engineering)

https://newengineer.com/insight/8-of-the-most-in-demand-engineering-jobs-for-2020-1126177 (engineering careers)

https://typesofengineeringdegrees.org/highest-paid-engineering-jobs/ (engineering careers)