



Everyday Engineering: STEM@Home



GRADE LEVEL:
ELEMENTARY
THROUGH
HIGH SCHOOL

Activity: Windy City Tower



INTRODUCE THIS:

People love tall buildings. They look dramatic, shape the skyline of a city, and can be a great way to save space in a crowded city. But tall buildings can sway in the wind. Civil engineers who design and build tall structures have to figure out how to keep buildings safe from the forces of the wind. Do you usually think of a skyscraper as a rectangular box on its end? It turns out that that shape isn't the only one that works.



WATCH THIS:

To see how engineers designed the Shanghai Tower, one of the tallest buildings in the world, using scale models and wind testing watch the short video Dream Big - Holding Sway: Wind Engineering, <https://youtu.be/GZ3kGReRGNO>



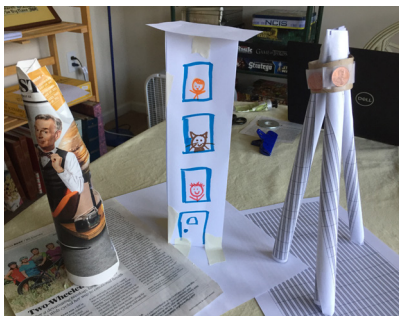
MATERIALS:

- 3 sheets of paper per person. No unused paper at home? Try recycling your mail or old magazines— Does that affect the strength?
- Tape—no more than 2 yards (6 feet)
- Scissors
- Ruler/yardstick
- A weight with a hole in the middle such as a large washer, a circle of beads on a string, a piece of bread with a hole in the middle. You can even tape pennies around the end of a paper tube.
- Paper and pencil for drawing plans
- Electric box fan or table fan or blow dryer



DO THIS:

The Challenge: Build a tower out of no more than 3 sheets of paper that supports a weight at least 9 inches above the surface of a table or floor.



In the original activity we used a large washer that weighs about 1 ounce, but you can use what you have on hand. Engineers need to take some time to plan what they are going to do. Take a few minutes to write/sketch your plan.



Check out the different papers and different weights. When you do this, make sure everyone uses the same kind of paper or weight!

Build it!

Now that you have a tower, let's see how it does in windy conditions

Set up a fan and mark off 1-foot intervals for 6 feet. Set the fan on low, put the structure at the 6-foot mark and see if it survives. Move it forward in 1-foot intervals until it blows over. How close could you get it?

For younger children declare the structure is a success if it survives when placed 3-feet away from the fan. For older children or added challenge try moving it even closer and turning up the power of the fan.



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TALK ABOUT THIS:

What were the results of the first test? If you tried again what changes did you make and why? Can you redesign the tower to withstand more wind or to hold more weight while doing so?



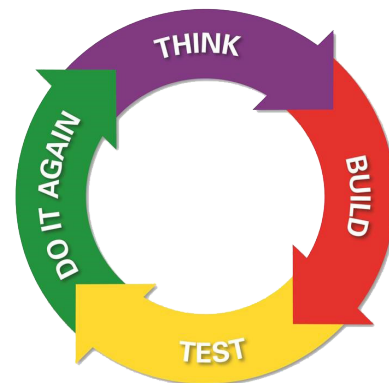
*All of these designs work even though they are different shapes.
Engineering is creative!*

Engineers use the Engineering Design Process in solving problems. This means that they think about the problem, design a possible solution, test it, then try again to see if they can improve.

Civil engineers often use models (small versions) of buildings in order to test how they will do in wind. This lets them find problems before building the full-scale version.

What shape is your building? A rectangular box? A cube? A pyramid? This is a great way to fold in some math concepts.

How is the shape of the Shanghai Tower different than most skyscrapers? Did it inspire you to try a different shape? Engineers often learn from each other.



WANT MORE CHALLENGE?

Increase the height of the tower. Still using only 3 sheets of paper how tall can you make it while still supporting the washer in the wind? Or allow more sheets of paper to make it even taller!

Increase the speed of the fan. Where in the world would it be best to have buildings able to withstand high winds? Where isn't that a problem?



WANT TO GO FURTHER?

This activity and over 65 others were developed in support of the award-winning documentary *Dream Big: Engineering Our World*. This version was adapted to showcase how to do it at home.

For more in-depth coverage download the Windy City Tower activity from the Dream Big website, <http://discovere.org/dreambig/activities/db-activity/Windy%20City%20Tower>. There you will find discussion questions for younger as well as older children, relevant vocabulary, and more.

Dream Big: Engineering Our World is available on Netflix and can also be obtained from Vimeo for \$6.99 for a 48-hour period of time or \$13.99 to view and download anytime.

The free library of over 65 activities and webisodes can be found at discovere.org/dreambig.