GRADE LEVEL: ELEMENTARY THROUGH HIGH SCHOOL

Everyday Engineering: STEM@Home

Activity: Build an Earthquake Resistant Structure

INTRODUCE THIS:

Designing earthquake-resistant buildings is extremely important in areas where earthquakes are common, like California and Japan. Buildings in these areas need to be designed to protect people and give them a chance to get out. There's no such thing as an earthquake-proof building, but engineers can figure out ways to reduce the damage and to keep people safe. One way to make a building strong is to use triangular shapes more than square ones. The official terms for this are using trusses and cross bracing.

WATCH THIS:

In the film, *Dream Big: Engineering Our World* (available on Netflix and Vimeo), engineer Menzer Pehlivan shares how living through an earthquake altered her life's dream. In the webisode *Dream Big - Quake Takes: Earthquake Engineering*, https://youtu.be/cY7iviX37-E you will see the world's largest outdoor shake table in action.

MATERIALS:

- Small box such as a shoebox
- Scissors
- Small balls such as marbles, ping pong balls, or golf balls
- Rubber bands
- Tape

Don't have these, or want to try a different approach? Consider a clothes dryer in operation.

MATERIALS FOR BUILDING A STRUCTURE

- 30 beams—toothpicks or pieces of spaghetti
- 30 connectors—miniature marshmallows or gumdrops

DO THIS

PART ONE: MAKE AN EARTHQUAKE SIMULATOR

Place a handful of marbles (or other balls) in the shoebox.

Trim the lid of the box to create a platform that rests on the marbles. Leave about 1 inch of space between the cut down lid and the side of the box.

Now that you have an earthquake simulator let's test some structures!

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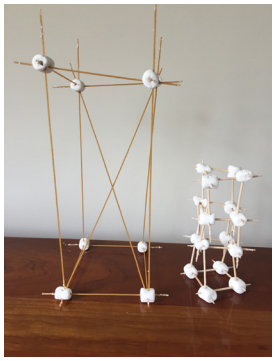
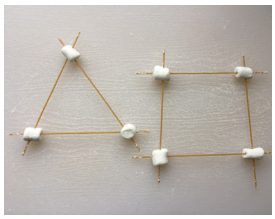
PART TWO: BUILD STRUCTURES FROM TOOTHPICKS AND MARSHMALLOWS

Using no more than 30 connectors and 30 beams design a structure that will hold up to an earthquake.

1. Before you start, make a triangle and a square using the connectors and beams. Press down on the shapes with your fingers. What do you notice? Is one shape stronger or weaker than the other? Which would be a better choice in constructing an earthquake resistant structure?
2. Plan your structure—draw a sketch
3. Build it
4. Test it. You can use two small pieces of tape to secure it to the lid.
    a. Start with a gentle earthquake. Use your finger to gently shake the lid. Observe how your structure moves.
    b. Gradually increase the strength. How hard do you need to shake the building to make it fail?
    c. Note weak points in your structure and think about how you can improve them..
    d. Make modifications and test again!





TALK ABOUT THIS

Was your first design successful at resisting an earthquake? Were you able to improve your design? What changes did you make? How do you think that engineers change their minds between original design and final product?

Why are triangles stronger than squares? Look up tension and compression for answers.

WANT MORE CHALLENGE?

Introduce a minimum height requirement or require the building to hold a certain amount of weight such as 5 pennies.

Change the number of connectors or beams allowed.

Build with other materials. If you used toothpicks originally try spaghetti next.

Download an accelerometer app onto a phone and place it on the lid during the “earthquake” to measure the intensity.

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 has been adapted to showcase how to do it at home.

For more in-depth coverage download the “Build an Earthquake-Resistant Structure” activity from the Dream Big website, http://discovere.org/dreambig/activities/db-activity/Build%20an%20Earthquake-Resistant%20Structure. 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 Vimeo.

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