Earthquake STEM Design Challenge

Much of Utah exists in the Wasatch Fault zone. Students will explore creating earthquake safe buildings through this fun STEM challenge.

Grade Level	3rd-5th Grade
Activity Length	30 Minutes
Materials	A book, piece of cardboard, wood, or any other stiff, flat material. 3-4 Pencils. (Or pens, marbles, or any other rolling materials) Popsicle Sticks, Pipe Cleaners. A paper and pencil for writing down notes, observations, and ideas.

Disciplinary Core Ideas
(PS2) Motion and Stability: Forces and Interactions
(ESS3) Earth and Human Activity
(ETS1.A) Defining and Deliminating an Engineering Problem
(ETS1.B) Developing Possible Solutions
(ETS1.C) Optimizing the Design Solution

SEEd Standards:

Standard 3.3.1 Plan and carry out investigations that provide evidence of the effects of balanced and unbalanced forces on the motion of an object. Emphasize investigations where only one variable is tested at a time. Examples could include an unbalanced force on one side of a ball causing it to move and balanced forces pushing on a box from both sides producing no movement. (PS2.A, PS2.B)

Standard 5.1.5 Design solutions to reduce the effects of naturally occurring events that impact humans. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution. Emphasize that humans cannot eliminate natural hazards, but they can take steps to reduce their impacts. Examples of events could include landslides, earthquakes, tsunamis, blizzards, or volcanic eruptions. (ESS3.B, ETS1.A, ETS1.B, ETS1.C)

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Much of Utah exists in the Wasatch Fault zone. This is a series of faults that run from Malad, Idaho near Fayette, Utah--a length of approximately 220 miles. This fault one marks the boundary between the Basin and Range Province, an area that is slowly being pulled apart in an east-west direction. While Utah's fault zone does not produce the most severe types of earthquakes, they can be severe enough to damage buildings and severely disrupt people's lives. For example, the earthquake that struck on March 18, 2020 damaged buildings and disrupted the life of Utahns for weeks as the aftershocks continued to hit.

Caution tape surrounds a damaged building on Magna's Main Street on Tuesday, March 24, 2020, following a 5.7 magnitude earthquake that was centered near the city on March 18. The street is now open to traffic. | Steve Griffin, Deseret News Utah just experienced a 5.7 earthquake. Here's what a 7.0 would look like (Article)

Because Utah lies in an active fault zone, buildings in Utah either need to be built or retrofitted (updated) to be able to withstand earthquakes. In this activity, work individually (if at home) or in teams to build structures that can withstand an earthquake.

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Directions

STEP One: Make a shake table. You will need a book ,a piece of cardboard, or wood, and something for it to roll around on. While this can be anything that rolls, 3-4 pencils will work. Place the pencils on a flat surface and then put your board on top of it. Practice gently rolling the book back and forth in small movements to mimic an earthquake.

STEP Two: Using a collection of popsicle sticks and pipe cleaners, build a cube. Place that cube on board and shake the table.

STEP Three: Write down your observations on what happened to the cube. For example, did it survive the earthquake? If not, how long did it last? Why do you think that this result happened?

If your structure survived the first earthquake, could it withstand the smaller aftershocks? Can it survive a larger, more severe earthquake? If you have time, test these questions and write down your observations.

STEP Four: Take apart the cube and build a pyramid. Place this pyramid on the board and shake the table?

STEP Five: Write down your observations on what happened to the pyramid. For example, did it survive the earthquake? If not, how long did it last? Why do you think that this result happened?

If your structure survived the first earthquake, could it withstand the smaller aftershocks? Can it survive a lager, more severe earthquake? If you have time, test these questions and write down your observations.

Step Six: Try building other shapes. You can use other supplies around your house or in your classrooms. How do your designs do on the shake table?

As with the previous experiments, write down your observations and test if it can withstand aftershocks.

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Extension Activities

People have been building earthquake-resistant and secure buildings for centuries. Watch some of these following videos or read some of these articles to learn how people in the past dealt with earthquakes and made their structures secure.

While watching these videos, write down the reasons why these old structures are able to survive such severe earthquakes.

How China Built Earthquake-Proof Palaces | Secrets Of China's Forbidden City
Secret of the Pagoda's Earthquake Resistant Design
Acropolis of Athens Was Built to Withstand Earthquakes, Engineers Say
The Mystery of Earthquake-Resistant Buildings at Machu Picchu | Strip the City
Ancient Incans Earthquake Proof Walls Inspire These 3-D Printed Modern

Questions:
What are some common structures in these earthquake-resistant buildings that help fulfill their function of resisting earthquakes?

Why is it important to look at the ways that older civilizations built buildings to survive earthquakes? What can we learn from this kind of history?

Think of your building design. Now that you have learned about older practices, if you were to actually build your design, would you include any kind of older earthquake-resistant building practices? Which ones would you use?