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STEM AT HOME ACTIVITY GUIDE:
Earthquake Resistant Structure Challenge

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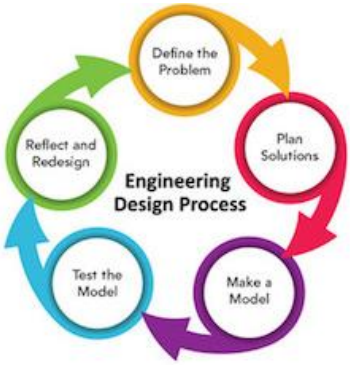
STEM AT HOME GUIDE: Earthquake Resistant Structure Challenge

Aim: Design a structure that can withstand the high velocity shaking of an earthquake.



Problem & Career Focus: The National Earthquake Information Center (NEIC) locates an average of 50 earthquakes everyday around the world. That's about 20,000 a year. Earthquakes can cause severe damage to homes, structures, roads, and more. It is important that any structure be built to withstand the force of earthquakes. Using the engineering design process, your task is to work with your team of seismologists, environmental engineers, and archeologists to design, model, and prototype an earthquake resistant structure.

Educational Standards Correlations: Engineering Design, Motion, Energy, Physics, Earth's Systems

Engineering Design Process: STEM professionals use the engineering design process as steps to help solve real-world problems. With your team: define the problem, discuss solutions, design, build, test, and improve a prototype of your solution. One of the most important steps of the engineering design process is to reflect and redesign- if your team notices your playground equipment prototypes aren't working then improve the design. Use the engineering design process steps to guide your exploration during the Earthquake Resistant Structure Challenge.

Investigating Questions

- What geometric shapes offer the most stability in a structure?
- What combinations of materials can you use to create your working equipment designs?
- What materials are used in construction of buildings to ensure safety of the public?

Materials

- Aluminum pan
- JELL-O
- Marshmallows
- Toothpicks
- Cardboard
- Scissors
- Timer
- Any other household materials!

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Background Knowledge

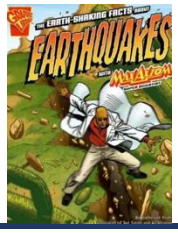
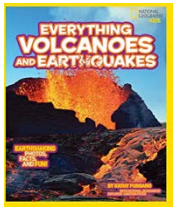
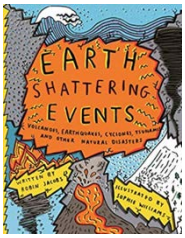
Vocabulary:

Force: the measurement of a push or a pull on an object. Force is measured in newtons.
Energy: the ability to do work. The standard unit of measure for energy is the joule.
Physics: the natural science that studies matter, its motion and behavior through space and time relating to energy and force.
Earth's Systems: interacting physical, chemical, and biological processes (consists of land, oceans, atmospheres, and poles).

STEM Career Connections:

Seismologist	Environmental Engineer	Archeologist
Are Earth scientists, specialize in geophysics, who study seismic waves in geological materials.	Are professionals that use engineering, soil science, biology and chemistry to develop solutions to environmental problems	Are professionals that study past earthquakes to investigate past human activity.
They: study earthquakes and their results, like tsunamis and landslides. They may also monitor volcanoes.	**They**: provide data relevant to the shape and contour of the Earth's surface for engineering, mapmaking, and construction projects.	**They**: use evidence left behind by earlier civilizations to inform and gather information.

Literacy Connections:

The Earth-Shaking Facts About Earthquakes	Everything Volcanoes and Earthquakes	Earth Shattering Events
by Katherine E Khron	by Kathy Furgang	by Robin Jacobs
		

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Background Knowledge

Real World Applications

Earthquakes, although dangerous, can be useful to humans because they provide information about what is going on underground. This can make oil and gas extraction more efficient and allows scientists to monitor the progress of underwater more closely.

Earthquakes

Earthquakes are the shaking, rolling or sudden shock of the earth's surface. They are the Earth's natural means of releasing stress. More than a million earthquakes rattle the world each year. The West Coast is most at risk of having an earthquake, but earthquakes can happen in the Midwest and along the East Coast. Earthquakes can be felt over large areas although they usually last less than one minute. Earthquakes cannot be predicted- although scientists are working on it.

What Causes Earthquakes?

There are about 20 plates along the surface of the earth that move continuously and slowly past each other. When the plates squeeze or stretch, huge rocks form at their edges and the rocks shift with great force, causing an earthquake. As the plates move, they put forces on themselves and each other. When the force is large enough, the crust is forced to break. When the break occurs, the stress is released as energy which moves through the Earth in the form of waves, which we feel and call an earthquake.

Engineering New Ideas: Earthquake Resistant Buildings

Surprisingly, wooden homes, made of log and lumber structures remain in place after strong earthquakes. Even bamboo is used! Engineers use flexible foundations, vibration control devices, steel, wood, and are inventing new materials to withstand the strength of earthquakes.

Earthquake Fun Facts!

- The largest earthquake ever recorded in the world was in Chile in 1960.
- Earthquakes cause huge waves in the ocean called tsunamis.
- Earthquakes can happen in any weather.
- The Moment Magnitude Scale (MMS) measures the strength of an earthquake.
- A 4.0 on the MMS scale could shake your house, but a 9.0 or higher would flatten an entire city.

Check out these video links!

Earthquakes 101
https://www.youtube.com/results?search_query=earthquakes+for+kids

Earthquake and Tsunami
https://www.youtube.com/watch?v=R0l6z0HaUAM

Tsunami Height Comparison
https://www.youtube.com/watch?v=DI9Y24SKPEg

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Activity Directions

Aim: Design a structure that can withstand the high velocity shaking of an earthquake.

Instructional Video: https://youtu.be/ocu4Go9w8e8

Investigating Questions

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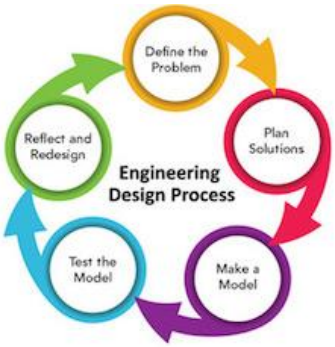

Materials

Aluminum pan
Toothpicks
Scissors
JELL-O
Cardboard
Timer

Criteria & Constraints:

Engineering design challenges (EDCs) are great opportunities for open-ended activities to grow critical thinking and problem-solving skills. EDCs do not use a list of directions to build a specific design, rather suggest a framework of designing a solution based on the problem and goal. How your team chooses to address the problem and goal is entirely up to you!

- Watch videos on earthquakes and their effects on buildings and homes. Discuss as a family how engineers design the structures to help withstand the strength of an earthquake (*Define the Problem*).

- Lay out all materials and items available for the challenge. Plan to give time for your team to discuss the problem relating to your background knowledge. How will your team use the materials to create a tall, but sturdy structure (*Define the Problem*)?

- Discuss, sketch, and determine what materials your team will use to create the structure (*Plan Solutions*).

- With an adult's supervision, make the JELL-O. Once complete, pour the JELL-O into the aluminum pan and refrigerate.

- Using your sketches and discussions, begin creating the structures from your model from materials available. Family adults: allow your child(ren) to experiment with the materials and help them build problem-solving skills (*Make a Model*).

- As you are building your structures, test out the models to make sure they can be flexible, but stay standing (*Test the Model*).

- When the JELL-O is ready, place your structure inside the aluminum pan on top of the JELL-O. Your team will shake the table, so the JELL-O creates an earthquake reaction to the structure. Discuss as a team what is happening to the structure.

- With your team, continue to discuss and work through problems with your designed models along the way. What adjustments can your team make to improve your design?

- If you were to make a new structure with different materials, what would you use or how would your model be different? (*Reflect and Redesign*)

Ideas to Increase Difficulty:

-Add an additional challenge of height- how tall can you create your structure to withstand the earthquake?

-Limit the number of materials that will be used.

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Sample Ideas

Photo's courtesy of: Teachers Are Terrific, Carly and Adam

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Extension Activity

Edible Tower

Materials:

All towers MUST be constructed from edible materials

Cookies	Crackers	Marshmallows	Fruits
Vegetables	Candy	Brownies	Pretzels

*Any other edible food in your home!

Criteria & Constraints:

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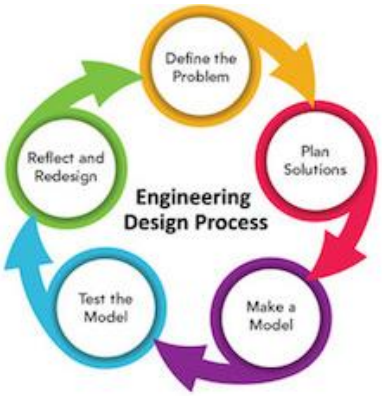

-In this challenge you are designing a tower from edible materials in your home. Your goal is to create your tower to be as tall as possible without being held or attached to a structure (free-standing tower)
-To increase level of complexity- add more materials!

- Research and brainstorm designs of towers/skyscrapers. How can they stand so tall? What materials can you use to create solutions to the problem (*Define the Problem*)?
- Sketch your prototype and design of key aspects of the tower and how to ensure it will stand by itself (*Plan Solutions*).
- Use research and the sketches to start brainstorming your prototype (What will the tower be made of? What materials can you combine to make the tower? (*Plan Solutions and Make a Model*)
- Plan your prototype: draw or sketch the design. Watch some videos on skyscraper construction! (*Plan Solutions and Make a Model*).
- Use your household materials to make a prototype of your tower *(Make a Model).*
- Test your design. Will you have to modify your design? Talk with your team about ways you could improve the design of your models (*Reflect and Redesign*).