Science Experiment:
Seismic Shake-Up
Project: Models, Small Engines, Weather & Climate Science

Supplies:

- Wooden or Plastic Coffee Stirrers (20-30 per group)
- Modeling Clay (1/4 lb per group)
- Manila File Folder or Thin Piece of Cardstock (1 per group)
- Ruler (1 per group)
- Cardboard Pieces (2 pieces per shake table)
- Thick Rubber Bands (2 per shake table)
- Tennis Balls (2 per shake table)
- Large Binder Clips (2 per shake table)
- Ruler or Paint Stirrer (1 per shake table)
- Masking Tape

Objective: **Design and build a structure that's stable and sturdy enough to survive an earthquake's vibrations. Must be at least 8 inches tall.**

Time: **45 minutes (25 build time, 20 minute test and debrief)**

What to Do:

Building the Shake Table

1. Wrap the rubber bands around the width of both pieces of cardboard. Space them about 4 inches apart.
2. Slide the two tennis balls in between the pieces of cardboard, and position them underneath each rubber band.
3. Tape the ruler (or paint stirrer) under the top piece of cardboard to make a handle.
4. Place two binder clips on top cardboard piece. These will be used to clip the group's folder onto the table for testing.
5. You can make additional shake tables if needed for larger groups.

The Activity/Experiment

1. Break everyone up into groups of 3-4 students. Make sure you have enough supplies for all groups participating.
2. Explain to each group that they will be building a structure that cans survive an earthquake. After they have completed their build, they will test it – as engineers do – on a shake table.
3. Demonstrate to the groups how the shake table will work (using the same back-and-forth motion as an earthquake.) They will be given a piece of cardstock/manila file folder to attach their structure to. That paper will then be clipped onto the shake table using binder clips.
4. Pass out the materials to each group that they may use to create their structure. Each group will get 20-30 coffee stirrers/sticks and about ¼ pound of modeling clay. Each structure has to be at least 8 inches tall, but no other specifications should be given.
5. Give groups 25 minutes to complete their structures. Remind them when they have 10 and 5 minutes left to keep them on task.
6. Test each structure on the shake table.
   a. Use one hand to hold the bottom of the shake table against the tabletop/surface.
   b. Pull the handle with the other and release. EARTHQUAKE!
7. If time allows, let groups make changes to their designs. What could be changed to prevent it from wobbling? Collapsing? Tipping over?

(over)

Reflect:

1. **What did you do to keep/prevent your structure from…**
   a. **…wobbling?**
   Cross-bracing. Using triangles vs. squares.
   b. **…collapsing?**
   Adding triangles/cross-bracing.
   c. **…tipping over?**
   Wider base.
2. **What are the strengths of your design? What are the weaknesses?**
3. **If you could redesign your structure, what would you change? What you improve/keep the same?**
4. **How safe do you think your structure is? Why?**

Apply:

1. **Would you feel comfortable/safe if you were inside your structure during an earthquake? Why?**
2. **Why was 'testing' your structure important? How do you think we test structures that are designed today vs. previous times?**
Testing your design ensures that you used the correct pieces and material to complete your design. It helps us to understand how well you turned your sketches or thoughts for a design into reality. Testing your design ensures that your thoughts (sometimes based on facts) are backed up by what actually happens (what you thought would happen actually did, similar to testing a hypothesis). A strenuous testing process is needed for structures (especially when they are in earthquake zones). These tests change by area and the natural disaster issues that are around (earthquakes, tornadoes, hurricanes, flooding).
3. **Why was it important that you were only given a certain amount of supplies? Similarly, what if we only gave you a certain amount of time?**
Many building and engineering projects are given a strict budget (amount of money/supplies to work with). Engineers must think through their build and design process with that limitation in mind. Often, engineers have to be creative in how they design and think about their design process because of the materials used, location of the structure, or time/money allotted to the project.

Facilitator Notes:
Hundreds of millions of people live in places around the world where earthquakes are common. Over 90% of the world's earthquakes take place in a rim around the Pacific Ocean, including areas like California, western Alaska, and Japan.

The two major causes of earthquakes damage are the intensity of the shaking ground and the quality of the buildings and the structures. Sometimes, moderate earthquakes can cause lots of damage while other massive earthquakes cause little to no damage – it depends on whether the buildings are well designed. Engineers play an important role in earthquake preparedness. While we can't control earthquakes, we can build better structures that can survive the forces involved. Engineers are constantly researching and testing new designs that help keep people safe.

Source: Discover E "Seismic Shake-Up" Youth Activity www.discovere.org