https://www.teachengineering.org/view_activity.php?url=http://www.teachengineering.org/collection/cub_/activities/cub_natdis/cub_natdis_lesson03_activity1.xml

Earthquake in the Classroom Activity

1. Summary: Students will learn how engineers construct buildings to withstand damage from earthquakes by building their own structures with toothpicks and marshmallows. Students test how earthquake-proof their buildings are by testing them on an earthquake simulated in a pan of Jell-O.
2. Engineering Connection: Because earthquakes can cause walls to crack, foundations to move, and even entire buildings to crumple, engineers incorporate into their structural designs techniques that withstand damage from earthquake forces, for example, cross bracing, large bases and tapered geometry. Earthquake-proof buildings are intended to bend and sway with the motion of earthquakes, or are isolated from the movement by sliders. Engineers come up with an idea, test it, and then re-engineer the structure based on its performance.
3. Materials Needed

Each student needs:

- 30 toothpicks
- 30 miniature marshmallows
- Earthquake Journal

For the entire class to share:

- eight 8½-inch square disposable baking dishes, or one 8½ x 11-inch disposable roasting or baking pan
- 8 boxes Jell-O® (plus a stove, water and pan to make the Jell-O® in advance)

4. Introduction: Earthquakes can cause much loss of life and millions of dollars worth of damage to cities. *Surface waves* and *body waves* from earthquakes can cause walls to crack, foundations to move and even entire buildings to crumble. Engineers continually strive to make buildings stronger to resist the forces of earthquakes. Engineers face the challenge of designing more stout buildings to withstand earthquakes. Earthquake-proof buildings are intended to bend and sway with the motion of earthquakes, instead of cracking and breaking under the pressure. Have you ever looked at a really tall building, such as a skyscraper? What does it look like? Does it appear fragile and unstable? It might, but it is most probably quite sturdy and can withstand wind, rain and other natural elements. Earthquake-proof buildings typically have cross bracing that forms triangles in its design geometry (like a bridge). Such buildings also typically have a large "footprint," or base, and a tapered shape, decreasing in size as the building gets taller (or simply, smaller at the top). Short buildings are more earthquake proof than tall ones. Why do you think that is? Have you ever climbed up a tree or been on top of a playground jungle gym in the wind? Do you sway more when you are up high than when on the ground? All buildings shake at the same frequency as the shaking of the Earth, but the movement is magnified as the building gets taller. Sometimes, as can be the case during earthquakes, buildings sway too much, crack and crumble and fall
5. Procedure:

Before the Activity

- Prepare the Jell-O the night before the activity so that it is fully set when students begin the activity. Pour the Jell-O® into eight 8½-inch square pans to be shared by four students, or in one large pan for the entire class to share.
- Make one marshmallow-toothpick structure as a display example for students.
- Gather materials and make copies of the Earthquake Journal.

With the Students

- Hand out student journals. Have students fill in the top left section of the journal with vocabulary terms. Direct students to record their activity observations as they work.
- Tell students that today they are acting as if they are engineers. They will make models of buildings and conduct an experiment to test how well their structures stand up under the stress of an earthquake. Explain to them that this is similar to what some civil engineers do as their jobs.
- Show students the display model of a structure.
- Illustrate how to make cubes and triangles using toothpicks and marshmallows. Show students how to break a toothpick approximately in half. Explain that cubes and triangles are like building blocks that may be stacked to make towers. The towers can have small or large "footprints" (or bases).
- Distribute 30 toothpicks and 30 marshmallows to each student. Explain that the Earth has limited resources, so therefore engineers also have limited resources when building structures.
- For this engineering challenge, students are limited to using only the materials they have been given to make structures. They may make large or small cubes or triangles by using full-size or broken toothpicks. They may use cross bracing to reinforce their structures. (Note: For higher grade levels, give students more rules for their buildings. You can use one or more of the following rules or create your own: buildings must be at least two toothpick levels high, buildings must contain at least one triangle, buildings must contain at least one square, or buildings must contain one triangle and square.)
- Place the structures on the pans of Jell-O®.
- If aluminum pans are used, tap the pans on the bottom to simulate compression or primary waves. If glass baking dishes are used, shake them back and forth in a shearing motion to simulate S or secondary waves.
- After students have tested their structures, have them redesign and rebuild them and finally test them again. What can they do to make it stronger? Did it topple? Should they make the base bigger? Make the structure taller or shorter? Let students design and rebuild as many times as the class period allows.
- Have students draw and label the shapes in their designs (cube, triangle, etc).
- Have students pretend that they are engineers who work for a civil engineering company. Instruct them to make a flyer to convince their company to let them design a better building or structure.
- Have students finish their journals,as directed in the Assessment section.