Earthquake in the Classroom

Name: _____
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Objectives:

- Identify some the factors that make buildings earthquake-proof
- Model an earthquake-proof structure using simple materials
- Compare a model structure with what it represents
- Understand why engineers need to learn about earthquakes

Introduction/Motivation:

Earthquakes can cause much loss of life and millions of dollars worth of damage to cities. Surface wave and body waves from earthquakes can cause wall to crack, foundations to move and even entire building to crumble. Engineers continually strive to make buildings stronger to resist the forces of earthquakes.

Engineers face the challenge of designing more robust 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. It might, but it is most probably quite sturdy and can withstand wind, rain, and other natural elements and phenomena. Earthquake-proof buildings typically have cross-bracing that forms triangles in its design geometry (like a bridge). Such buildings also typically have large "footprint," or base and tapered shape, decreasing in size as the building gets taller (or simply, smaller at the top). Short buildings are more earthquake proof compared to tall ones. 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.

Materials:

- 30 toothpicks
- 30 miniature marshmallows
- Shake Table (boards, rubber bands, bouncy balls)

Procedure:

1. Today you are acting as if you are an engineer. You will make models of buildings and conduct an experiment to test how well your 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.
2. The teacher will distribute 30 toothpicks and 30 marshmallows to each group. Explain that the Earth has limited resources, so therefore engineers also have limited resources when building structures.
3. You will be limited to the materials provided to you.
    a. You may make large or small cubes or triangles by using full-size or broken toothpicks.
    b. You may cross brace to reinforce your structures.
    c. Buildings must be at least two toothpick levels high.
    d. Building must have at least one square and one triangle
    e. All materials must be used in your building
4. Draw the design of you building in the space provide following the procedure.
5. When completed, place and tape the structure on a shake table.
6. Grab the top board of the shake table, and lightly pull it and let go of it to test the stability of your building. Repeat a few times to test the stability of the building.
7. Make observations of what you noticed with your building as it experienced the shake table earthquake.

My Building:

Shake Table Observations:

Discussion and conclusion: Answer all questions in complete sentences.

1. What did you observe about your building as it was subjected to an earthquake? Did it topple?

2. What do you think were the strengths and the weaknesses of your building during an earthquake?

3. How would you redesign your building? How would you make it stronger; should you have a wider base? Should you make it taller or smaller? Explain how your modifications would help earthquake-proof your building. Make a drawing of your redesigned building.

4. Use what you have learned today to examine your school for earthquake engineering. Do the school buildings encompass some of the principals of earthquake proofing? Explain your answer.