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| <p><b>Description</b><br/>This activity is meant to extend your students’ knowledge of the topics covered in our Engineering for Earthquakes lab. Through this activity, students will practice engineering design principles and be responsible for creating their own earthquake platform.</p> |   |   |
| <p><b>Grade Levels</b><br/>5-8</p>   | <p><b>Student Outcomes</b><br/>Students will:</p> <ul style="list-style-type: none"> <li>• Use the engineering design process to design and construct their own earthquake simulating shake table.</li> </ul> | <p><b>Next Generation Science Standards</b></p> <ul style="list-style-type: none"> <li>• Engineering Design<br/><b>Grade 5:</b> 5-ETS1-1, 2, 3<br/><b>Grades 6-8:</b> MS-ETS1-1-4</li> <li>• <i>Science and Engineering Practices</i>-<br/>Developing and using models to describe phenomena</li> </ul>   |
| <p><b>Duration</b><br/>Three 45-minute periods</p>   |   | <p><b>Common Core ELA Standards</b></p> <ul style="list-style-type: none"> <li>• Writing                             <ul style="list-style-type: none"> <li>• <b>Grade 6-8:</b> W.7</li> </ul> </li> <li>• Speaking and Listening                             <ul style="list-style-type: none"> <li>• <b>Grade 5:</b> 5.SL.1b-d</li> <li>• <b>Grades 6-8:</b> SL.1b-e</li> </ul> </li> </ul> |

| Materials  |   |
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| <ul style="list-style-type: none"> <li>• Medium sized box, 12 x 12” if possible</li> <li>• Piece of cardboard that fits inside the box with 1” clearance on all sides.</li> <li>• Hole punch</li> <li>• Masking tape and/or duct tape</li> </ul> | <ul style="list-style-type: none"> <li>• Hot glue</li> <li>• Scissors</li> <li>• Toothpicks</li> <li>• Mini marshmallows</li> </ul> |

### Teacher Note

We encourage you to let your students try and figure out the design of their shake table for themselves, but if you or your students are in need of some inspiration, please see some of the links below:

- [http://www.sciencebuddies.org/science-fair-projects/project\\_ideas/CE\\_p023.shtml#procedure](http://www.sciencebuddies.org/science-fair-projects/project_ideas/CE_p023.shtml#procedure)
- <https://www.pinterest.com/pin/125819383312979275/>
- <http://www.juicygeography.co.uk/shaker.htm>
- <http://teachers.egfi-k12.org/activity-earthquake-proof-structure/>

### Procedure

1. Students will work as teams of four or five for this activity.
2. You can provide the materials students will need for steps 6 and 7 or you can have students bring materials from home.



## Day 1

1. Begin by reminding students of the shake table used in the Engineering for Earthquakes—the table was able to move up and down as well as side to side to properly simulate an earthquake.
2. Student teams will be designing and constructing their own shake table to further simulate their own earthquakes.
3. Each team will receive one box and one piece of cardboard that fits inside. Show teams the box with the platform inside.
4. The goal is to make the platform inside the box shake vertically, horizontally, or both (depending on grade level).
  - a. Ask student teams what kind of materials can be used to make the platform move vertically or horizontally. What are the materials? How would they be placed in the box or platform? What kind of motion will that material produce? Will the box or platform need to be altered in some way?
  - b. If you are providing possible materials (e.g., ping pong balls, marbles, springs, etc.), show them to students so they know what options they have.
  - c. If you are not providing possible materials, let students know that they will be responsible for bringing in the materials needed to make their shake table so they can brainstorm accordingly.
5. Constraints:
  - a. The platform must stay inside the box.
  - b. The platform must move in the chosen direction (vertically, horizontally, or both).
  - c. The platform and box can be manipulated, but not reconfigured (i.e., the box or platform can have cuts, slits, or holes made in it but neither can be cut into pieces).
6. Give student teams about 20 minutes to brainstorm how they will make their shake table.
  - a. For younger grade students, you can provide some examples of materials and how they would be used to produce the desired vertical or horizontal motion.
7. After students have brainstormed what materials they will use, have them sketch out what their shake table would look like, with labels and the number of each material they will need.
8. Collect their sketches and brainstormed ideas so they will have them for the next day.
9. If not providing materials, remind students that they need to bring in their selected materials for the next day of putting together the shake table.

## Day 2

1. Remind students that their shake tables need to move either horizontally, vertically, or both depending on what you have selected for them to accomplish.
2. Hand out team sketches and let them get to work on building their shake tables. Give at least 30-40 minutes for construction and testing time. (Students can test with any item on their platform).
3. While students are constructing their tables, walk around and ask questions about their design process.
  - a. Did brainstorming with your team help?
  - b. How did you pick the materials you were going to use?
  - c. Is the chosen material working the way you thought it would? Why did you pick this material?
  - d. What have you changed from your sketch? What has stayed the same?
  - e. Have there been any unforeseen complications?
4. At the end of construction time, have teams share with one other team how their shake table works and what their design process was.
  - a. If more time is needed and time permits, construction can be extended to two days.

## Day 3

1. Today students will test out their shake tables with actual structures on them.
2. Have teams build simple cube structures using the toothpicks and mini marshmallows. For the first few



tests, all structures should be two cubes on top of each other.

3. Each team will first test their shake table individually to see how it worked. Give teams about 10 minutes to make adjustments to their table if necessary.
4. Have each team present their shake table, explain their design process and test it out with a marshmallow structure. Students need to be able to explain why they chose a certain material to give their table the desired vertical or horizontal motion.
5. Discussion points:
  - a. Which table had the best motion?
  - b. Which table used the most creative materials?
  - c. Did brainstorming and sketching really help? Why or why not?
  - d. After seeing other groups' tables, would you do your table differently?
6. If time permits, let student teams gently test out other groups' tables.
7. Testing can continue with different structures if time permits.