creativity lab

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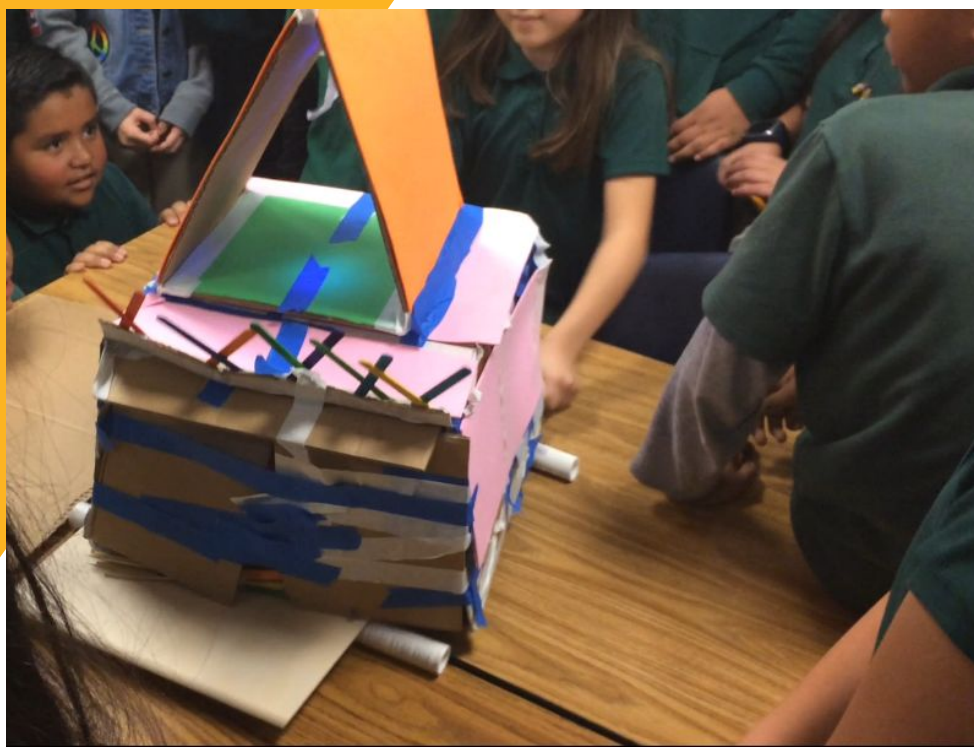
# EARTHQUAKES & HOUSING

*A Guide from the Creativity Lab*



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# About This Project

This project is part of a 3rd and 4th grade unit on natural disasters. Students were introduced to natural phenomena such as earthquakes, typhoons, volcanic eruptions, tsunamis and wildfires. This unit offered the chance to discuss how natural disasters affect the community, to promote empathy and awareness of current housing situations, to ask what steps are taken to prevent damage, and what jobs and careers are related to this topic.

By showing students relevant examples of civil engineering, architecture, and design, we wanted to inspire them to design, troubleshoot, and build a solid model of a building.

This guide provides a step-by-step description of how to create the shake table, on which students will place their structures. Building the structures can be done in groups of 4-6 students and can progress over at least 4 classes of 40 minutes each.

# Our Story

This project is a variation of different online STEM projects related to earthquakes. As a warm-up, students were asked to predict the behaviour of sample buildings as they were placed on the shake-table (e.g. Would a really tall and thin structure fall down easily? What about a shorter one whose weight is off balance?). For the construction of the buildings, we challenged the students to not use hot-glue, and to find ways to use masking tape, string, dowels, slots and other "mechanical" construction techniques for cardboard.

The students showed a lot of enthusiasm for the project, and came up with interesting cardboard solutions! We recommend that enough time is given after the activity to prompt reflections and peer feedback.

# Materials & Tools

**MATERIALS FOR STRUCTURES**

- Cardboard pieces, pre-cut
- Foam
- Masking tape
- Popsicle sticks
- Skewers
- Corks
- Construction paper
- Paper/plastic tubes
- String/yarn
- Elastic
- Other craft materials

**MATERIALS FOR SHAKE TABLE**

- Thin balsa sheet (1'x2')
- PVC tubing (2-3 feet)
- Elastic or rubber-band (16")

**TOOLS**

- Scissors
- Drill (for shake-table)
- Saw (for the shake table)

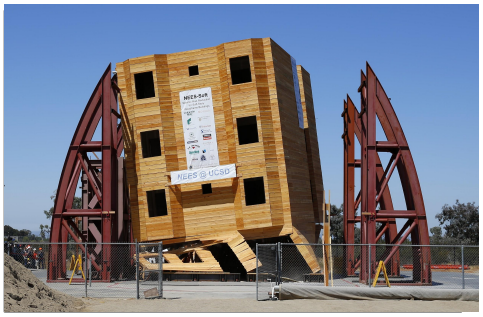
**TIME**: 4 classes of 40 min

# Learning Targets

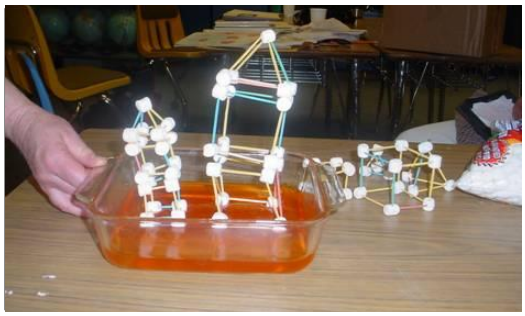
- I can explore complexity.
- I can create a structure that lasts 10 seconds on the shake table
- I can use field-related vocabulary
- I can work in a group/team
- I can clearly define a problem or need.
- I can explicitly borrow and build on others' ideas.
- I can improve my work based on self-reflection.
- I can relate ideas and works with societal, cultural, and historical context to deepen understanding.
- I can test designed solutions to defined problems and take next steps on the basis of my testing.

# Context: Before we make...

This activity was designed to incorporate interdisciplinary and real-world connections:. it builds on different online STEM projects that relate strictly to physics and environmental science content, to which we added **design, social, and professional-related elements**. Students are shown real-life examples of earthquake-proof buildings and solutions, and are introduced to the professions of architect and, most importantly, civil engineer. As it happens in real life, construction and design present a series of limitations and challenges (ex. budget/time/material constraints). So we decided to give the students a couple of design challenges as well: to aim to get the construction as high as possible, and to avoid altogether the use of hot-glue. Below are resources for school activities and real-world applications.



Technologies for earthquake-resistant buildings ©MIKE BLAKE/REUTERS/CORBIS



TechEngineering.org STEM activities

Disaster-proof Housing STEM project

**Other references:** What makes a Building Earthquake-proof (one-sheeter), MakeHER Program (video), Images of Earthquake-proof buildings (Google search)

# Material Management

- Cardboard can be collected (in class or outside) a couple of weeks before the project
- Cardboard can be precut to different sizes as it might be difficult for younger children to cut through it
- Optional: each group could have their own shake-table to test on while building
- Allow enough time after the activity (~ 10 min) for cleaning up, as things will get pretty messy!
- The material list for the construction of the buildings is not rigid, so feel free to use whatever is within your means (budget, time etc...). A little cardboard and tape goes a long way!

# How to Introduce New Tools & Tech SAFELY

- Divide students into groups of 5-6 each. Have them sketch down individually what their structure would look like. Then have them collaborate on finalising one building.
- Have each group/table collect materials from the bins one at a time, so there is no bottlenecking
- Here, our design challenge was to use only tape and cardboard-construction techniques (scoring, slots, etc...)
- If you are unable to prep the cardboard yourself, bandage-scissors have proven to be quite useful when cutting through thick cardboard.

# Step-By-Step Guide

This Step-by-Step guide is a tutorial for creating the shake-table. For our activity, we used scrap PVC tubes, (but you can use any other sturdy tubes, like thick cardboard) and thin plywood sheets. Feel free to make changes with the materials you have preferences working with.

1. Cut the tubes so they are as wide as the sheet you are using. You can use a canary knife, saw or sharp blade. You need two tubes per sheet.
2. On each end of the tubes, drill holes about an inch from the end.
3. Drill 4 holes into your sheet where you want the tubes to be placed. The holes should be roughly at least 5-6 inches from the shorter side of the sheet, and at least 1 inch from the longer edge.
    a. We found the best placement for the tubes was centered underneath the sheet (rather than near each edge), since the sheet would fall off the tubes when moving.
4. Pull an elastic or rubber-band (3-4 inches long) through the holes in the tubes and sheet.
5. Tie knots at the ends of the rubber band.
6. You are ready to shake! Have each student/group place their structure on the base. Two students can roll the platform back and forth for about 10 seconds (fast enough so that there are 2 “shakes” per second).

At Lodestar, we created a drill-powered shake table to investigate different building braces, and later to test scale models of downtown Oakland structures. HERE is a step by step guide to create our table.

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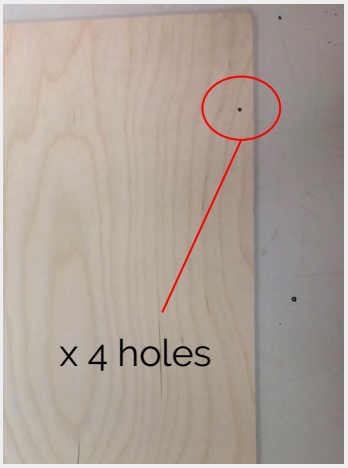
2.




3.

4.

5.

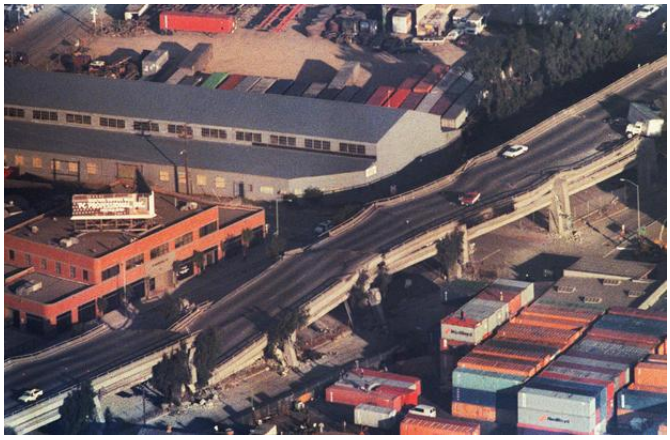
6.

Lodestar’s Shake Table

# Reflection & Community Connection

This project was created to prompt reflections on housing and natural disasters, and the relevance these phenomena have in our area (California, and the Bay Area in particular), and how they affect our community.

Real-life connections should be made as often as possible in order to cement learning and develop agency with students. Students should be shown, in a way that is thoughtful, optimistic yet realistic, how sustainability is a key element in construction and in the development of buildings and homes, and is vital to the safety of our community.

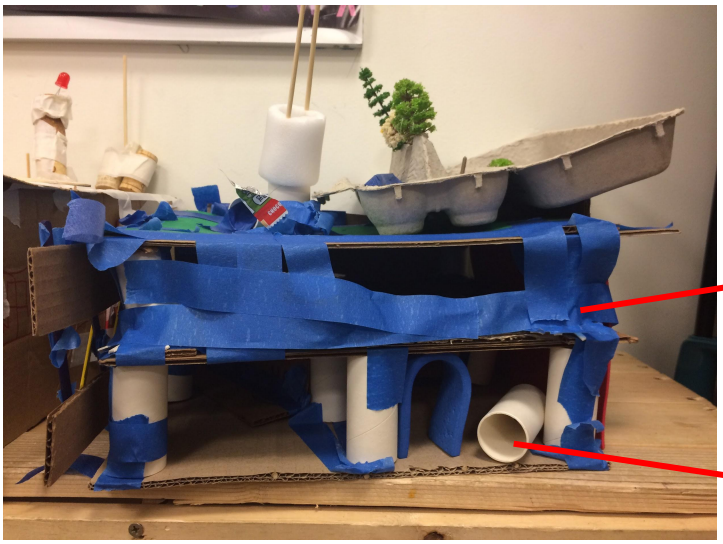


Aftermath of the 1989 earthquake in Oakland. This image could be used as a starting point ("discrepant event") of a *provocacion*

As an introduction to the activity, we created a brief presentation of future career connections, focusing on the one of civil engineer. This is a very short summary of the many possible career connections that can be made: architecture, environmental science, seismology, urban developers etc…

Students were also shown (in lieu of a field-trip) examples of earthquake-resistant structures. This is a one-sheeter that explains simple construction techniques used by engineers when designing buildings. If you have time, you can create small cardboard models that illustrate these techniques and that serve as physical examples for the students.

After the activity, provide the students with some kind of reflection journal so they can document their thinking and make it visible.



## Student Example

The design challenge was to hold the building together only with tape!

Students created a "base isolation" with tubular objects