RAFT IDEAS

**Topics:** Earthquakes, 3-dimensional shapes, Applied mathematics

## Materials List

- ✓ Bamboo garden stakes
- ✓ Masking tape
- ✓ Scissors
- ✓ Safety goggles
- ✓ Matte knife (for the teacher's use during clean up)

This activity can be used to teach:

- Two and three-Dimensional shapes & objects (Common Core Math Standards: Geometry, Grade 6, 4)

Next Generation Science Standards:

- Mitigate the effects of Earthquakes (Middle School, Earth and Space Science 3-2)
- Geoscience process changing Earth's surface (Middle School, Earth and Space Science 2-2)
- Forces & Motion (Grade 3, Physical Science 2-1, 2-2)
- Waves ( Grade 4, Physical Science 4-1)

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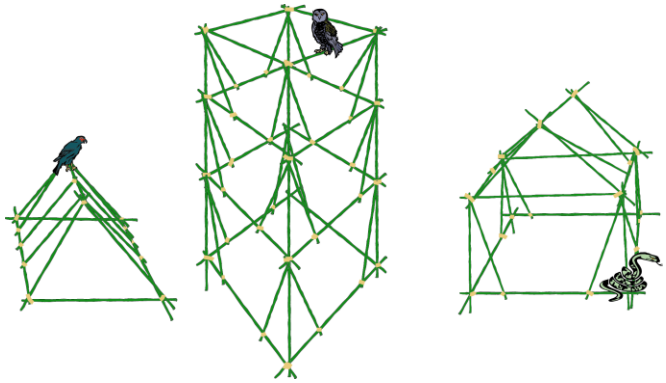
# Garden Stake Structures

Using bamboo to explore earthquake resistant building designs



Building with garden stakes brings geometry into the real world and allows students to explore structural engineering. In particular, students can discover the importance of triangular components in building sturdy structures.

## To Do and Notice

Note: Building with garden stakes can be potential eye hazard; to minimize risk, students should wear goggles.

1. Use pieces of masking tape to join garden stakes together build a 3-dimensional shape or structure. Pieces of masking tape should only be wrapped around twice at any particular location. Structures must be free standing.
2. When the structures are complete, simulate earthquakes by subjecting the structures to various degrees and durations of shaking. Which shapes resisted collapse the best?
3. **Optional:** Take photos of the structures students build before earthquake simulation and tear down. With a photo as a lasting memoir of their creations, students will be more willing to subject their structures to "earthquake damage" or to tear down their structures.

## The Science Behind the Activity

Structures are formed by joining members (i.e. - the beams or pieces that become part of an assembled frame or structure). Triangles are of critical importance in the building of structures because they are the strongest shapes formed by joining members. When a force is applied to a triangle in any direction, there will always be a member that will brace against the force. When forces are applied to structures made from polygons with 4 or more sides, large deformations of the structure are possible with minimal force. Buildings comprised strictly of rectangular framing, without diagonal braces, will tend to fail during serious earthquakes.

The triangular systems built into the supports, spans, and reinforcements of buildings are called trusses. Trusses help create strong and efficient structures that resist collapse during earthquakes.

**Web Resources** (Visit www.raft.net/raft-idea?isid=75 for more resources!)

For more structure-based activities, visit The Exploratorium's website at: http://www.exploratorium.edu/structures/index.html

Adapted from activities written by The Exploratorium
Instructions by Jay Gluckman (RAFT)