[*On the Cutting Edge - Professional Development for Geoscience Faculty*](http://serc.carleton.edu/NAGTWorkshops/index.html)

Environmental Geology

Montana State University- Bozeman, MT

***Liquefaction Demonstration*** (Norlene Emerson)

**Introduction**

I use this demonstration while teaching a unit on earthquake hazards. Liquefaction is an occurrence that can cause great damage during earthquake events in soils or unconsolidated sediments. It primarily occurs in saturated soils where most of the spaces between individual soil particles are filled with water. Since the voids in the soil are filled with water, there is water pressure exerted on the surrounding soil particle. When an earthquake occurs, seismic waves shake the saturated soil which causes the grains in the soil to squeeze together. This squeezing in turn increases the pressure that the water exerts on the soil particles. Therefore the sediment particles cannot exert as much pressure on one another allowing the particles to easily slide relative to one another. The soil loses its strength allowing the foundations of structures on the soil to sink into the ground.

**Demonstration**

In order to demonstrate liquefaction behavior on structural foundations, an experiment was developed using materials readily available in the classroom. The materials used for this demonstration are a:

1. Small, clear plastic or rubber container

2. Standard building brick, or any metal object, or even a rock. The brick could be painted to look like a building.

3. Sand to fill the container

4. Water to saturate the sand

5. Rubber mallet or regular carpenter’s hammer

Fill the container with the sand and place it on a table. Add the water carefully to the perimeter of the container. Ideally, for the best liquefaction effects, the water should be just below the surface of the sand. Place the brick on the sand to represent a building. Demonstrate how strong the foundation is by pushing down on the brick. Using the hammer, tap the edge of the container to simulate earthquake vibrations. The brick will sink into the sand as the sand begins to liquefy and water will rise to the surface.

**Extension**

Following the demonstration, I show a video clip of liquefaction that occurred in Tokyo Japan due to the May 12, 2011 8.9 Mag earthquake. <http://www.youtube.com/watch?v=I3hJK1BoRak>

**Liquefaction maps:**

I follow up the lecture with an assignment that uses several liquefaction maps such as:

USGS San Francisco Bay Region <http://geomaps.wr.usgs.gov/sfgeo/liquefaction/index.html>

Earthquake and Hazards Program <http://quake.abag.ca.gov/liquefaction/>

State of California Department of Conservation: <http://www.conservation.ca.gov/cgs/shzp/Pages/Index.aspx>

USGS Fact Sheet 028-03 “Subsurface Exploration with the Cone Penetration Testing Truck:

<http://pubs.usgs.gov/fs/2003/fs028-03/>