Lab 8: Stress Triggering and Prediction

Overview: Students will investigate the 'randomness' of earthquakes, first through a simple Plinko game and second by revisiting the table-top earthquake machine.

Objectives: (1) Test 'time-predictable' nature of earthquakes (the larger the slip in the last earthquake, the longer the wait until the next one)
(2) Test randomness of earthquake occurrence and size

Materials:

- Instruction sheet/worksheet
- Large backboard
- Wooden pegs or long nails
- Poker chips (or something like)
- Table-top earthquake machines (already built)
- Surgical rubber tubing (better than elastic chord?)
- Talcum/baby powder
- Ruler
- Stopwatch
- Computer access

Teacher Prep: Students will participate in a game of 'Plinko' (from the Price Is Right) to demonstrate basic statistics of random variables and 'chance'.

For this exercise, students will test two primary hypotheses:

(1) Earthquakes are 'time-predictable' (this means that the larger the slip in the last earthquake, the longer the wait until the next one). This idea was formulated in the 1980's by Shimazaki and Nakata in Japan and has been widely used.

(2) Earthquakes occur randomly in time and have randomly varying size. (This 'Poisson' hypothesis is also widely used, particularly when little information about a fault and its past earthquakes is available).

Using the earthquake machine, students can mark off the "rupture length" during each "earthquake" by seeing how far the brick slips. They likely will find that the lengths are not consistent. Next students will time the "earthquakes" assuming a constant speed by the person operating the wench. Again, time will not always be consistent either. If they turn the crank slowly as the cord nears "failure", they may hear the sandpaper crackle a moment before the brick moves, thus simulating a foreshock. An additional brick should also be included in the exercise (students should hypothesize what this will do to the experiment before-hand). The additional brick be stacked atop the first brick to produce larger "earthquakes." It can also be removed from atop the first brick just at the moment of failure to show that slippage can occur even without additional stress, just by removing

the additional brick. Supplemental reading material *Parkfield's Unfulfilled Promise* by Ross Stein should compliment these activities.

Still using the earthquake machine, students should place a second brick (equipped with surgical tubing as well) in tandem with the first brick. In this way, the machine demonstrates how earthquakes "talk" to each other. When stress is sufficient, the first brick moves forward, increasing stress on the second brick. Eventually the second brick slips, reducing the backwards force on the first brick, and the first brick can slip again. Supplemental reading material *Earthquake Conversations* by Ross Stein should also compliment these activities.

If there is time remaining, students should be directed to the following website for an up-to-date summary on scientific efforts of earthquake prediction and analysis:

http://tsunami.geo.ed.ac.uk/local-bin/quakes/mapscript/front_page.pl

The final portion of their worksheet should have a single question about current global earthquake predictions.

Notes:

- Make worksheet
- Ref: http://quake.wr.usgs.gov/research/deformation/modeling/eqmodel.html