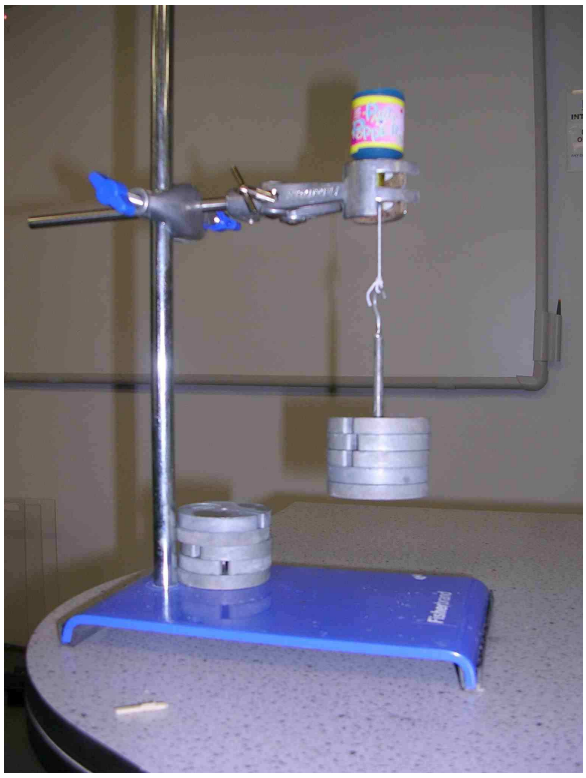
Party time for volcanoes!
How much force does it take to set off a party popper "volcano"?

Eruption of the volcano Stromboli.

Demonstrate how difficult it can be to predict when sudden Earth events will be triggered. In reality, this could be an explosive volcanic eruption, a landslide or the sudden failure of rock masses leading to an earthquake. Use several party poppers and measure the force required to set them off.

Set up three clamp stands, each with a party popper firmly clamped in place. You will first need to tie the string to make a secure loop, in order to hold a mass hanger, as shown in the photograph. Don't clamp the party popper too high up the stand, to avoid a big crash when it explodes! Watch out for masses dropping to the floor. Ask three students to take a clamp stand each and explain that they will be loading their mass hangers carefully, adding one 100g (1N) mass at a time, until the party popper goes off. Before they start, ask the class to predict how much mass it will take to set off the party poppers. Then ask the three students to add each mass gently so that they don't suddenly jerk the apparatus. They should avoid putting their heads above the party popper.

When all the poppers have duly popped and the fun has subsided, ask the class how they think this relates to the real world. There is usually considerable variability between the three different party poppers (*a range from 300g (3N) up to 3300g (33N) has been found so far – for the latter, it is necessary to add another two mass hangers, each of which itself has a mass of 100g (1N).*)



A party popper under stress – to say nothing of the onlookers! (Photo: *Peter Kennett*)

Note: You can do the same activity without the clamps, stands and masses by using a Newton Meter to trigger the party poppers and measuring the necessary force – but is not so noisy or so much 'fun'!

The back up

Title: Party time for volcanoes!

Subtitle: How much force does it take to set off a party popper "volcano"?

Topic: Measuring the force required to burst a party popper and relating the variable results obtained to the prediction of earthquakes, landslides and volcanic eruptions.

Age range of pupils: 8 - 80 years!

Time needed to complete activity: 10 minutes, with a few minutes preparation time, mainly in tying a string loop on the party poppers.

Pupil learning outcomes: Pupils can:

- carry out a simple exercise dexterously and fairly;
- measure the increasing force required to burst a party popper;
- relate their own results to those of their colleagues;

- debate why there may be major differences in the force required;
- discuss the relevance to the real world;
- understand why the prediction of earthquakes and volcanoes is difficult to achieve (although we can **forecast** the statistical likelihood of a dramatic Earth event, it is usually impossible to correctly **predict** the time and place).

Context: This activity provides a quantifiable way of measuring a gradually increasing stress, akin to the build up of pressure beneath a volcano, or the increases in stress as rock masses begin to move relative to each other.

Following up the activity:
Try the Earthlearningidea activities *When will it blow? – predicting eruptions*, and *Earthquake prediction - when will the earthquake strike?*

Underlying principles:
- Most earthquakes are caused by the build-up of stresses in the Earth being suddenly released as friction is overcome and rocks fail.
- Landslides involve similar stress build up and failure.
- In many volcanoes, gas pressures build up underneath the surface, until the pressure exceeds the force exerted by the overlying rock and an eruption takes place.
- Measurements of stresses between rock masses or of the tilt of a volcano's surface are monitored by remote sensing instruments and may aid the prediction of eruptions, landslides or earthquakes.
- Prediction of eruptions, landslides or earthquakes remains almost impossible and it is seldom possible to give precise timings of anticipated events, to allow the evacuation of populations to safety.

Thinking skill development:
- Prediction of the outcome of adding the masses involves construction;
- Explaining why students' predictions were not always fulfilled involves cognitive conflict;
- Metacognition is involved as the group discusses the outcomes;
- Linking the model to the real world requires skills in bridging.

Resource list:
- at least three party poppers, with the strings tied into firm loops

EITHER
- three clamp stands, clamps and bosses
- three 100g mass hangers
- 100g masses (up to 90 may be needed if all the party poppers are stubborn!)

OR
- Newton meters (10N and 50N)

Useful links:
http://earthquake.usgs.gov/monitoring/deformation/data/

http://earthquake.usgs.gov/learning/kids/ for lots of information on earthquakes.

http://news.nationalgeographic.com/news/2004/07/0720_040720_earthquake.html

www.mvo.ms for updates on the monitoring of the volcanoes on the island of Monserrat.

Source: Based on the workshop titled "The Earth and plate tectonics", Earth Science Education Unit (ESEU), © The Earth Science Education Unit: http://www.earthscienceeducation.com/ licensed under an Attribution-Noncommercial-Share Alike 3.0 Unported Creative Commons licence http://creativecommons.org/licenses/by-nc-sa/3.0/

This activity was originally devised by David Turner of the ESEU.