EARTHQUAKE CLASSROOM ACTIVITIES

Modelling an earthquake with a brick and sandpaper

Students use a brick and sandpaper to model the characteristics of earthquakes. They record the amount of slip produced each time the brick moves, and the force before and after each slip. Turning the pulley to build up tension in the string is like the buildup of stresses at a fault, and the brick movement over the sandpaper is like the slippage that happens in an earthquake.

Resources needed

Each group will need (refer to image below):

- a simple pulley
- a plank of wood
- a house brick
- coarse sandpaper, plus adhesive tape or G-clamps to stick it onto the plank
- a force meter (e.g. 0-20 N, 0-50 N)
- metre rule or tape measure
- temporary adhesive putty or double-sided tape to stick the ruler down (optional)
- straw pointer, plus something to stick it onto the brick
- graph paper
- eye protection

Learning objectives

Students will:

- compare the relative frequencies of slip size with real earthquake data
- observe force build up, slippage and release over several slip cycles
- compare this with the pattern of stress build-up and release in different earthquake models

Notes

This arrangement with a force meter provides a steady increase in tension in the string, equivalent to stress building up in a seismic fault. The pulley can be clamped to a corner of the bench, or could be screwed onto the plank or runway to provide an integral unit.

The area of the brick in contact with the plank represents the fault and is a constant size. You may need to experiment with different combinations of brick and sandpaper to get the best effect: the brick shouldn't move as soon as you start to turn the pulley but should 'go' suddenly.

You may prefer to use sandpaper on the bottom of the brick, too, and to use bungee cord in place of the string attached to the brick.

Task A focuses on the relationship between how often earthquakes occur and their size. Students should find that the slip size can vary considerably from one 'slip' to another.

Task B is an additional task about using a model to predict when an 'earthquake' will occur and what determines how big it is likely to be. It can really only be done with access to data logging equipment with suitable force sensors, because it is too difficult to establish reliable values of forces by looking at the reading on a force meter as the brick suddenly jerks then stops. If this is not possible, preliminary observations of the force before slippage should still allow students to establish that the force reading can vary quite considerably from one 'slip' to another.

Task instructions

Exercises

Task A: Looking at the buildup of forces

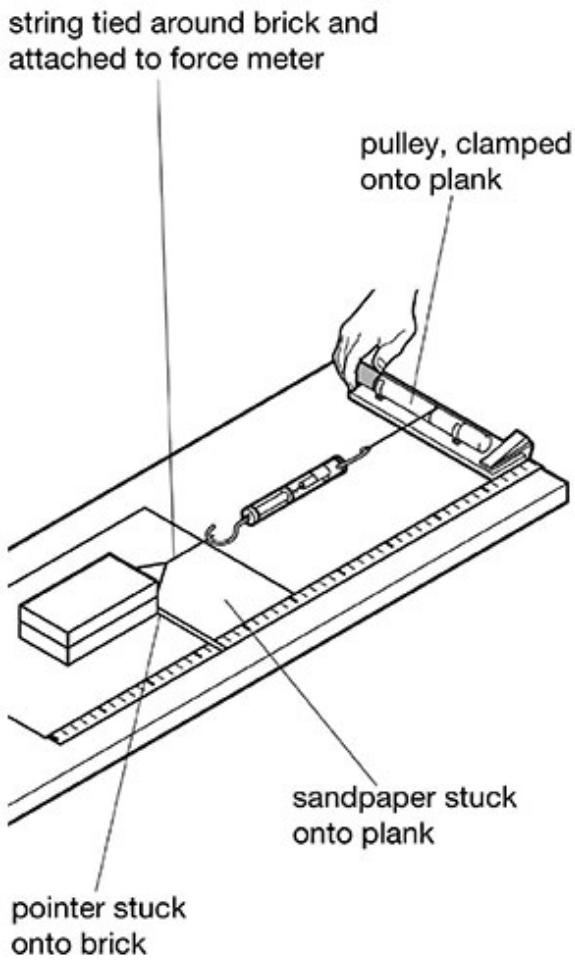

Figure 1 Using a brick and sandpaper model to investigate stress and slip.

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1. Make sure the pulley is clamped onto the plank and attach the string from the pulley onto the force meter.
2. Use another string attached to the force meter to tie around the brick.
3. Stick or tape a ruler with a mm scale onto the plank and a pointer onto the brick: you should be able to measure the position of the brick against the scale to the nearest mm.
4. Start the brick at the end of the sandpaper furthest away from the pulley: make sure it is completely on the sandpaper.
5. Wear eye protection. Turn the pulley so it gradually increases the tension in the string (and the force on the brick) until the brick starts to move. Increase the tension slowly so that it takes several seconds before the brick slips.
6. Try this a few times. Watch what happens to the force meter reading: does the brick always begin to slip when the force reaches the same value?

Task B: Looking at the amount of slip

Pointer position (mm)	Slippage (mm)
500	**0 (Start position)**
505	**5**
512	**7**
515	**3**
525	**10**

1. Place the brick back at the start position. This time, measure how far the brick moves each time it slips. Record your results in a table like the one shown here.
2. Continue until you have at least 30 readings.
3. Plot a histogram to show the frequency for each size of slippage.
4. What do you notice about the relative frequency of large slippages?
5. Compare your histogram with a histogram showing the frequency of different magnitudes of earthquake.

Task C: Patterns, predictions and models

If you have access to a data logging kit with a force sensor, you could investigate some or all of the following questions:

1. Does the force return to a particular value after every slip?
2. Do bigger forces lead to bigger slippage?
3. Is there a critical level of force which triggers slippage?
4. Is there a relationship between the force drop and the size of slippage?
5. What patterns does your earthquake model show? Can we use it to predict when an 'earthquake' will happen or how big it will be?
6. Compare your results to standard earthquake models.