EARTHQUAKE

Purpose

To simulate the movement of an earthquake and to investigate the relationship of the fault displacement to the following:

- ***friction***
- ***compressibility of the crust***
- ***velocity of movement of the crust either side of the fault***
- ***frequency of movement***
- ***applied force in the direction of movement***

To see what variation in displacement there is even when all the variables are kept constant.

The amount of friction is related to the force perpendicular to the fault plane and the roughness of the fault plane. In this experiment the perpendicular force is increased by adding weights to the upper piece of wood and the roughness of the fault plane by using different grades of sandpaper.

The compressibility of the crust is simulated by the elastic bands or spring balance and can be altered by adding extra bands.

The velocity of movement of the crust is simulated by pulling the block over the sand paper.

The fault displacement is measured by marking the position of the block each time it stops and from this the frequency of movement can be calculated.

The force is measured both immediately prior to movement and immediately after by noting the reading on the spring balance.

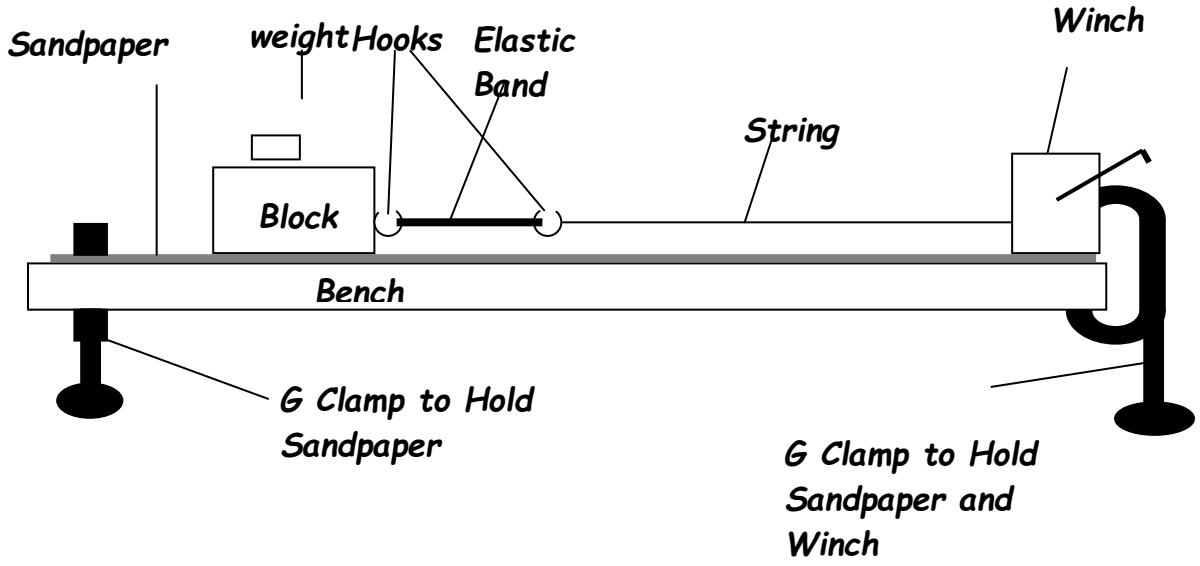
General Instructions Varying the elasticity, velocity and force

You will need a trial run.

1. ***Draw up a table like the one on the next page.***

2. ***Choose one of the factors as a variable and keep the others fixed.***

Sandpaper grade				
Length of time				
weight				
elasticity				
number of stops				
total length of movement				
average displacement				
velocity of movement				
maximum slip				
minimum slip				



3. *Set up the apparatus as in the diagram. Always use at least 500g weight on the blocks. Use bluetack to hold a 1m strip of till roll paper along the side of the long piece of sand paper.*

4. *Mark both on the table and on the till paper your name, the sandpaper grade, the number of elastic bands and the weight on top.*

5. *Start the stop watch and turn the handle to pull the block of wood. The handle should be turned slowly (one turn per ten seconds or less) and continuously without slowing or stopping. If the block starts to slide continuously you are turning the handle too fast and you should stop and start again.*

6. *Mark each stop point on the till paper (but not the starting point).*

7. *When the wood is <u>nearly</u> at the end stop the stop watch and stop turning the handle.*
8. *Complete the table.*

9. *Repeat the experiment two more times and then change your variable by adding another elastic band or by adding a weight. Either replace the till roll strip or use a different colour the mark it.*

Instructions for varying the elasticity
Use either one, two, three or four elastic bands of the same size together on the same hooks. You can put the bands in a line to represent a rock with high elasticity (compressibility).

Instructions for varying the frictional force
Use 0.5, 1.0, 1.5, or 2kg placed on top of the wooden block.

Instructions for varying the roughness of the fault plane
Use different grades of sandpaper. The sandpaper for block and the strip should be the same.

Instructions for measuring the velocity of movement
Do one run turning the handle very slowly, then next turning it at twice the speed, say one turn every 10 seconds and one turn every 5 seconds.

Instructions for measuring the maximum and minimum force
One person turns the handle, and the other marks the till roll, watches the spring balance and writes down the minimum and maximum force. You will need a trial run.

1. *Set up the apparatus as in the diagram but replace the elastic bands with a 20 Newton spring balance. Do not use the stop watch.*

2. *Turn the handle very slowly. Stop turning as soon as the block begins to slide*

3. *Note the maximum force, just before the block slips, and the minimum immediately after it slips.*

4. *Mark the new position of the block on the till strip and measure the displacement*

5. *Complete the table for 50 movements.*

weight		*Sandpaper grade*		
number	*Maximum force*	*Minimum force*	*Change in force*	*displacement*
1				

6. *Add an additional weight to the block of wood and repeat these instructions.*

Instructions for determining the variation in displacement.

1 Follow the general instructions using 1kg weight, 60 grade sandpaper and 1 elastic band. Make at least 100 displacements.

2 Once you have completed a run measure every displacement marked on your paper strip to the nearest millimetre.

3 Type these into Xcell and sort them by length, or tally them

4 Make a table like this with sufficient lines to cover all your lengths

Length	*number*
0 – 9	
10 – 19	
20 – 9	
30 - 39	
40 -	

49	

5 Plot your results on normal graph paper.

Teacher's Section

Requirements

Three blocks of wood 5cm by 10cm by 30cm
Spring balance for 20N
Timer
Four identical elastic bands each about 5cm long
String, 3 pieces 1m long and safety pins to attach string to elastic bands
Winch (see below)
2m strips of till roll
Weights 0.5 to 2kg
Sand paper strips of various grades, say 60, 80, 120. For each grade:
One strip 1m long and one 35cm the latter fixed to the wooden block.
2 G clamps, Blue tack or masking tape to hold till strip down
Strip of wood 5cm by 3cm by 1cm to hold sandpaper strip down.

Making the apparatus (2 hours)

Use 4 drawing pins to attach 35cm piece of sandpaper to wooden block and then screw a cup hook into the centre of the end.
The winch is made by bending a piece of aluminium 5cm by 25cm into a U shape and drilling holes for a crank (see photo). The string should leave the winch at the same height as the hook on the block. Alternatively the winch can be made from meccano.

Notes

It is important to stress that the handle must be turned very slowly.
This activity needs to be done in pairs or threes if using spring balances.

Results

There is a clear relationship between the number of elastic bands and the displacement: the more bands in parallel the less displacement. There is no relationship between the weight and displacement. Displacement generally increases with roughness and speed. The greater the change in force the greater the displacement and the maximum force precedes maximum displacement which might be useful for prediction.

Time

2 hours but this can be reduced by different groups of students investigating different variables.

Based an article by M.Hall-Wallace in Journal of Geoscience Education v46 1998