

A valley in 30 seconds - pulling rocks apart Investigating faulting in an empty box

Make a valley – by using the empty plastic box from the 'The Himalayas in 30 seconds!' activity in a different way – this time by pulling 'rocks' apart. Place the vertical board about half way along the box and ask someone to hold it there or place a small block behind it. Build up layers of dry sand and flour on one side of the board only, nearly up to the top of the box, as in the first photograph. (Any powder with a different colour from the sand may be used for the alternate layers. The powder need only be added to the front of the box, which the pupils will watch).



How to set up the box

Ask pupils to watch carefully as you gently pull the board away, keeping it vertical (moving it to the left in the photo).

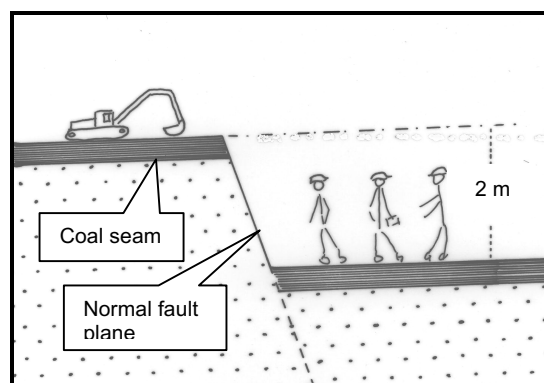


Successive stages in producing a normal fault – and a 'rift valley'

There will be some avalanching of sand grains next to the board, which is of little significance. However, a clear break will usually occur a few centimetres away from it, where the layers of sand on one side slip down in relation to the rest of the layers in the box (as in the photographs). The plane along which this slippage occurs is known as a **normal fault** plane. This is typical of situations where rock masses are being pulled apart and the rocks on one side slip downwards under gravity.



A normal fault in an opencast coal mine. The students are standing on a coal seam which has been dropped down by about 2 m along the grey coloured fault plane, compared to the same seam higher upon the left. (All photos: Peter Kennett)



Sketch cross section of the above picture, showing the faulted coal seam.

Where normal faulting happens on a regional scale, two such faults can occur on either side of a piece of land, forming a valley. Valleys caused by tensional faulting like this are called rift valleys.

The back up

Title: A valley in 30 seconds - pulling rocks apart

Subtitle: Investigating faulting in an empty box

Topic: Modelling how tensional forces can cause fractures in rocks, sometimes creating rift valleys.

Age range of pupils: 9 – 18 years

Time needed to complete activity: About 10 minutes, if it is built up in front of pupils

Pupil learning outcomes: Pupils can:

- describe how tensional (pull-apart) forces can result in normal faulting of rocks as they slide down under gravity;
- explain why a rock layer, like a coal seam in a mine, may suddenly stop – to be discovered higher or lower on the other side of a fracture in the strata;
- explain how a large scale feature, such as a rift valley (e.g. the East African Rift Valley) might have formed.

Context: This activity could be used to extend a physics lesson on forces, or to aid understanding of surface features such as fault scarps (steep slopes along a fault plane) and rift valleys. Faults are also important in forming traps for oil and natural gas, and as pathways for mineralising fluids. So, although they may have negative effects in coal mining, faults may be of great economic importance.

Following up the activity:

- Ask pupils to draw pictures of the faulted layers in the box.
- Try a websearch for details of faults and how they are formed.
- Find pictures of other faulted rocks and ask pupils to say in which directions the forces acted that created the structures.
- Discuss the connection between faulting under tensional conditions and plate tectonics at divergent margins, (older pupils).

Underlying principles:

- Forces produce deformation of the rocks that they are acting upon.
- The sand layers are deformed on a particle by particle basis: this is akin to the deformation of rocks on a molecule by molecule basis.
- Rock is weak in tension and horizontal tensional forces cause the rock to fracture. This leaves sections of rock upon which gravity can act vertically so they slide downwards along clearly defined planes.
- The fault which results is called a **normal fault** and the fault plane lies at a high angle, at times even vertical.
- Quite commonly, a second normal fault develops, with the rocks in between being faulted down, to form a rift valley.

- Tensional forces are typical of constructive plate margins, e.g. at the Mid Atlantic Ridge in Iceland (see photo), or the East African Rift Valley.



A narrow rift valley in Iceland. The sides of the gorge have been pulled apart, and are not due to erosion by a river.

From the American Geological Institute, Earth science World Image Bank .

(<http://www.earthscienceworld.org/images/index.html>). Photo ID: h2a4mw, copyright © Bruce Molnia, Terra Photographics

Thinking skill development:

- A pattern is established of a high angle fault being produced by tension. There is a direct bridging link with faulted structures, such as rift valleys.

Resource list:

- small transparent plastic or glass box, e.g. a component tray, or a rectangular plastic container, such as a milk container, cut in half
- a piece of board to fit snugly into the box
- dry sand
- a block of wood to hold the board vertical
- flour, or any powder of contrasting colour to the sand
- spoon etc for adding the sand and powder to the box

Useful links: See simple animations of faulting at <http://www.iris.washington.edu/gifs/animations/faults.htm>

Source: Earth Science Teachers' Association (1992) *Science of the Earth 11 – 14: Earth Surface Features*. Sheffield: Geosupplies.

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