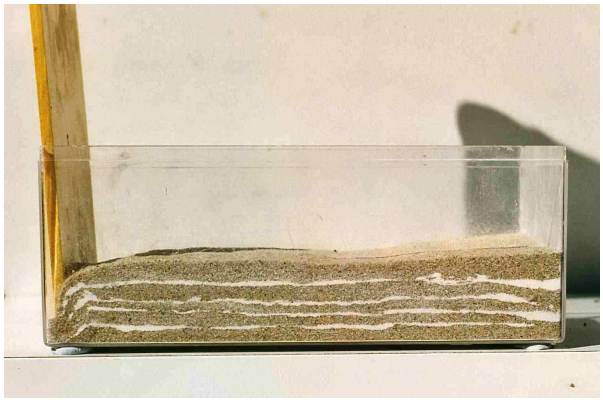
The Himalayas in 30 seconds!
Making a miniature fold mountain range in an empty box

Show pupils the ammonite fossil (an extinct sea creature) in Photograph 1. This lived and died in the sea, yet one like it was found in rocks 5000m high in the Himalayas. How could this be?
Explain that the Himalayas were formed when India collided with Asia, ie. the Indian sub-continent was pushed into the Asian land mass, by plate tectonic processes. We are going to imitate what happened to the layers of rock on the sea floor, which lay in between the two land masses.
Build up several flat layers of dry sand and flour in an empty transparent box, with a piece of board standing in one end (see Photograph 2). (Any powder with a different colour from the sand may be used for the alternate layers. It need only be added to the front of the box, which the pupils will be watching). Do not fill the box more than half-full.
Very carefully, push the board across the box, so that it begins to compress the sand and flour layers, stopping at intervals to see the result. Usually, the layers buckle up into a fold, and some of them become overturned (turned upside-down: Photo 3).
Eventually, one set of layers slides over the rest, producing a fault (a reverse fault, the type caused by compression). The upper surface of the sand rises to the top of the box, imitating the rise of the layers of rock to form mountains like the Himalayas.

Photograph 1: An ammonite fossil, like one found at 5000m up in the Himalayas.
(Each scale bar = 1 cm)



Photograph 2: How to set up the box

Photograph 3: Folded and faulted layers in the box

Photograph 4: Folded and faulted rocks at the Lizard, in Cornwall, England. Large scale sideways compression, like that you saw in the box, caused these rocks to buckle and break millions of years ago. *(All photos: P. Kennett)*

The back up

Title: The Himalayas in 30 seconds!

Subtitle: Making a miniature fold mountain range in an empty box.

Topic: Modelling how lateral pressure can squeeze rocks into folds and faults, and imitating the way in which fold mountain ranges are formed.

Age range of pupils: 9 - 18 years

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

Pupil learning outcomes: Pupils can:

- describe how lateral forces can produce folds and faults in layered materials;
- explain how a mountain range might have been formed from layered rocks if the forces were big enough. (Not all will easily be able to make the link between this activity and the Earth itself.)

Context: This activity could be used to extend a physics lesson on forces, or to aid understanding of the ways in which Earth's surface features affect weather systems such as the monsoon, in geography.

Following up the activity:

- Ask pupils to draw pictures of the folds at intervals as they are formed – to produce a sequence of the deformation effects.
- Try a websearch for details of fold mountains and how they are formed.
- Find pictures of other folded and faulted rocks and ask pupils to say in which directions the forces came that created the structures.
- Discuss the connection between mountain ranges and plate tectonics, with older pupils.

Underlying principles:

- Forces produce deformation of the rocks that they are acting upon.
- When there is movement, the force working on the board overcomes friction within the sand, causing it to fold, and also works against gravity, causing uplift.
- Force x distance = work done. It requires less work to move the sand particles nearest the board than at a distance from the board. (Distance in the equation is the amount of movement of the board).
- This is why an asymmetrical fold is produced by two equal and opposite forces.
- Folding (plastic deformation) normally precedes faulting (brittle deformation).
- The reverse faulting produced by compression is called thrusting, if it is at a low angle.
- 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.

Thinking skill development:

- A pattern is established of folding and faulting being produced by compression.
- There is a direct bridging link with fold mountains, although the concept may be difficult for younger pupils to grasp.
- Pupils face a challenge (cognitive conflict) when they think about the origin of other mountain ranges, e.g. the Andes, Rockies, where there is no second continent to "squeeze" the rocks. (In these cases, the continental plate where the mountains are located is being forced against the adjacent **oceanic** plate).

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
- flour, or any powder of contrasting colour to the sand
- spoon etc for adding the sand and powder to box

Useful links: 'Make your own folds and faults' and other activities involving deformation, in 'The Dynamic Rock Cycle', on the Earth Science Education Unit website:
http://www.earthscienceeducation.com/

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