STRUCTURAL GEOLOGY

Deformation

Styles of deformation D

These items can be used to demonstrate different styles of deformation to the class.
To show elastic deformation: elastic band, sponge or plastic ruler,
to show plastic deformation: copper wire, clay, plasticine or bluetack,
to show brittle deformation: thin piece of wood or piece of blackboard chalk.

Styles of deformation A P 15 min

The purpose of this activity is to get students to work out the different styles of deformation for a variety of materials. This can then lead to a discussion on what causes different materials to deform in different ways and the transition from one type of deformation to another. Students are given one each of the following: elastic band, piece of sponge (3cm cube), piece of rubber, cocktail stick, plasticine, piece of lead sheet (2cm by 5cm), piece of copper wire, strip of thin plastic e.g. plant label stick, piece of polystyrene tile
Students deform each item and to say whether it deforms elastically, plastically or if it breaks. After they have done that ask them if any materials showed more than one type of deformation.

To show change between styles of deformation I or D 2 min

Elastic band stretched to show elastic deformation and then stretched further until it snaps.
Strip of wood bent slightly to show elastic deformation and then bent until it snaps.

To show the effect of rapid and slow deformation D

Take two pieces of silly putty and hit one with a hammer and it will shatter showing brittle deformation, and put a small weight on the other and it will deform plastically.

To show effect of time on deformation D

Plastic ruler bent to show elastic deformation and then bent and held bent for at least one day after which it will be permanently deformed.

To show effect of heat ***D***

Gently heat a plastic ruler to show that it looses its elasticity and becomes plastic

To show change in shape ***D or P 2 min***

Place a cube of soft plasticine (or bluetack or putty) between two plywood boards. Or use finger and thumb instead of boards. Press down on the top board to change the shape by direct pressure or change the shape by applying a shearing force. This is good for starting a discussion of Pmax and Pmin etc

To show change in volume ***D or P 2 min***

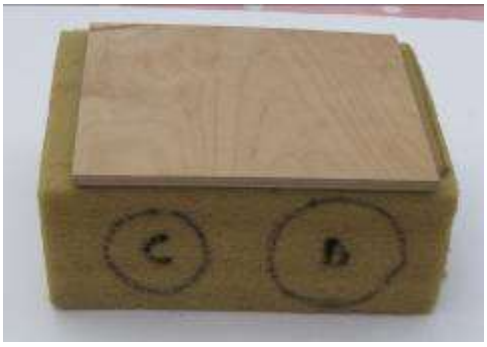
Use a piece of sponge between two plywood boards. Press down on the top board (Clay is the only geological material which will significantly change volume).

Stress and Strain ***E P F 15 min***

To show how the amount of strain increases with increasing stress.
A piece of sponge is sandwiched between two pieces of plywood and is placed on some kitchen scales. Pressure is applied to the top piece of plywood and the pressure read on the scales at the same time as the thickness of the sponge is measured.

Reduction spots ***D***

Circles of several sizes are drawn on a rectangular piece of sponge. A piece of plywood is placed above the sponge and used to compress it. The circles change to ellipses in the same way as the initially circular reduction spots do in clay when it is under pressure from the sediments above.



Reduction spots ***A P 15 min***

Several reduction spots are cut in half at right angles to the bedding. Their maximum and minimum diameters are measured. The reduction spots were originally circular so by comparing the maximum and minimum diameters one can determine the amount of compression of the strata.

Shearing ***D***

To show how beds change thickness when subjected to simple shear place a 2cm cube of very soft plasticine or putty between two small pieces of plywood. Push the top board sideways while holding the lower board in place.

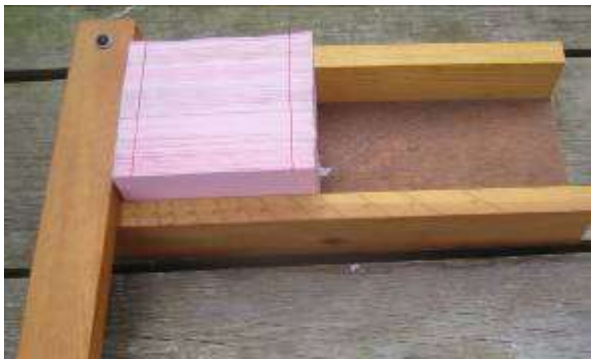
Squeezing putty ***D or A P 30 min***

You can show the effects of compression and shearing on oolites by using a sheet of putty stamped with a circle resting on wet glass.

Squeeze sand box ***D F***

This is a glass sided box with alternating layers of sand and sugar or sand and flour. A screw mechanism compresses the sand from the side and causes the development of folds and thrusts. If operated so that the layers are stretched then normal faults form.

Change in thickness of a bed with simple shear E P F 20 min
Filing cards are placed in a box which allows them to be sheared and the angle of shear and the change in shape measured.



Change of shape of an oolith with simple shear E P F 30 min
To show how pebbles and oolites change shape when sheared, filing cards with a circle drawn on are deformed in a shear box and the diameters of the ellipse plotted against angle (see photo above). The cads should be numbered before the circle is drawn so that they can be put back in the correct order if they are dropped.

Change of shape of an oolith with simple shear D
To demonstrate how pebbles or oolites change shape when sheared use a pack of playing cards with a circle drawn on the edges. Make sure the cards are in order before drawing on the circle.

Squeezing plasticine E P F 30 min
To show how oolites and pebbles change shape when compressed place a cube of soft plasticine with a circle stamped on in a vice for holding wood.

The diameters of the circle are measured and correlated with the changing distance between the jaws of the vice.

Plastic and brittle deformation *A P 2 min*

Mars bars are cut from top to bottom lengthwise and given to students. They bend the bar and note which layers deform plastically and which break.

You can also put a slice of Mars bar in the fridge to show the effects of cooling on deformation.

Formation of boudins *D F*

The formation of boudins can be demonstrated using a line of touching pieces of wood with a layer of putty either side. When compressed at right angles to the layers the pieces of wood move apart.