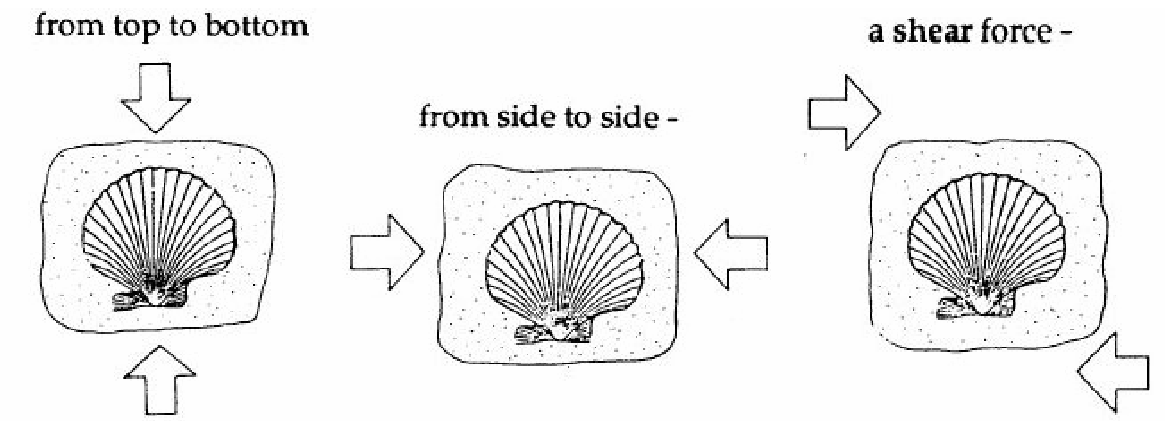
Deformation:
Making deformed fossils.

The aim of this experiment is to find out how the squashing (compression) of the Earth's crust during mountain-building episodes can lead to the formation of "mis-shaped" or deformed fossils. Such fossils can give Earth scientists important clues about the forces that squashed the rocks in the past.

You will need: some soft Plasticine™ or modelling clay, two small blocks of wood, and a selection of sea-shells.

You will also need: a plastic cup, stirring rod, water, and a supply (about 50g) of Plaster of Paris.

1. Soften some modelling clay and press it into a more or less square, flat tablet.
2. Select a suitable shell and press it well into your clay tablet to make a *mould* (or imprint) of the shell.
3. Now, very carefully remove the shell and, if necessary, straighten out your clay tablet so that the mould is the right shape again.
4. Choose **one** of the following three ways to *deform* your "fossil mould" and then squash the clay tablet between two wood blocks in the direction of the arrows, but *do not squash too much.* Remember which method you chose.



If you are working in pairs, then each partner should make their own mould but shouldn't let the other partner see which shell or how it was squashed.

5. Pour about 1cm depth of water into your plastic cup and stir in enough Plaster of Paris to make a runny cream. Each partner should then pour enough to fill his or her mould. Leave the plaster to set for a few minutes.
Wash your stirring rod, but leave any excess plaster to set in the cup.
6. Scratch your initials on your plaster cast and then carefully remove it from the clay mould.

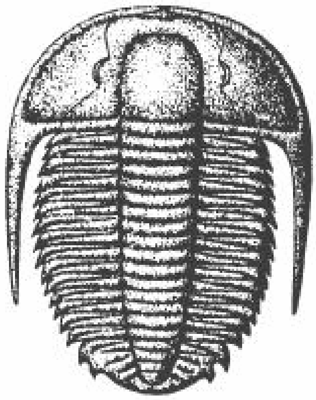
Now try swapping your "deformed fossils" with your partner.
Can you tell:
(i) Which shell they used?
(ii) Which way the mould was squashed?

Try the same with your neighbouring group. Then discuss these questions:

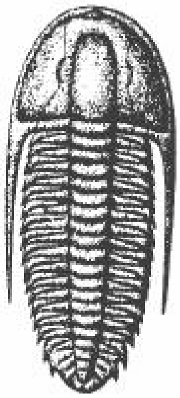
(i) How do you think that what have learned might help if you found a deformed fossil in a rock outcrop (a beach, or cliff, or quarry)?
(ii) Could *similar* distortions be produced by forces from *different* directions?

Deforming Fossils – a supplementary exercise:

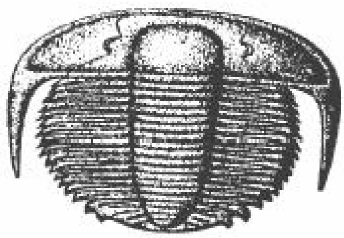
Drawing **A** shows a fossil trilobite, a creature related to crabs and lobsters, that lived on the sea floor many millions of years ago.



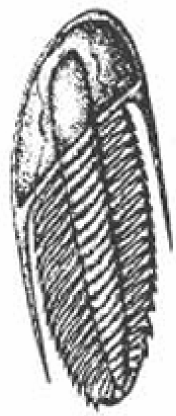
A



B



C



D

Drawings **B, C** and **D** are of fossils of the *same species* of trilobite that were found in rocks that have been squashed and folded.

(a) How can scientists tell that these are all trilobites of the same species?

(b) Draw arrows on each of the diagrams **B, C** and **D** to show how you think they were squashed.

(c) Measure the *width* of trilobite **A**
Measure the *width* of trilobite **B**
Work out the following sum: $\frac{(\text{width of A} - \text{width of B})}{\text{width of A}}$

What does this sum tell you?

(d) Repeat for the *length* (top to bottom) of trilobite **A** and the *length* of trilobite **C**

What does this sum tell you?

(e) What do calculations like these tell you about the rocks in which the fossils were found? What might be wrong in your calculations?

Teacher/Technician Notes:

1. ***Background:***
This experiment can easily be tied in with research based on the Deformation & Metamorphism web-pages. It is an experiment that involves creativity as well as good science, and is enjoyed by all ability levels.
Deformation in rocks is often very difficult to quantify; one way in which this can sometimes be done is through the use of deformed fossils. These can reveal not only the directions of principal stress (directions of maximum and minimum pressure) but also the *amount* of deformation of the rocks in any given direction expressed as a fraction or percentage, as determined by comparison of deformed and undeformed shapes (see supplementary exercise)
A “real-life” example of fossil deformation, the “Delabole Butterfly” is featured in both the Deformation pages and in “Rocks around Britain”.

2. ***Apparatus & Materials:***
Straightforward materials and equipment are needed (see “You will need…”); Plaster of Paris can be obtained from craft shops as well as most lab suppliers. Sea shells will need to be collected; these should simply comprise separated bivalve mollusc shells i.e. cockle-shells and the like…. whelks and their ilk are *not* suitable.

3. ***Preparation for experiment:***
Instructions are fairly extensive, so will need checking through with students. There is potential for some mess, so a bit of forethought is a good idea!

4. ***Supplementary Exercise:***
This is mainly aimed at able students who will be able to carry out (possibly with a little assistance), and understand the relevance of, calculations that reveal the degree of deformation of the fossil trilobites, and hence of the rocks in which they were found.
It should be noted that such calculations rest on certain assumptions:
Were the original fossils the same size? (not necessarily, but that problem can be overcome if the *shape* of both deformed and undeformed fossils is known)
Have the fossils been deformed by the same amount as the surrounding rock material? (if the material of the fossil is different to that of the surrounding rock, then probably not)

5. ***Follow-up:***
The study of fossils is something that interests many students although it finds little space in the national curriculum. This experiment provides an opportunity to encourage students to find out more for themselves – there are several good UK websites dedicated to fossils and fossil collecting… teachers may like to research a few of these for themselves!

Lastly, a point that has not been made elsewhere in these web pages: although deformed fossils are useful as a method of determining deformation in low-grade metamorphic rocks like the slates of Cornwall or parts of Wales, higher-grade metamorphic processes rapidly destroy fossil remains as recrystallisation of the original rock material progresses – by and large, fossils are *absen*t from medium and high grade metamorphic rocks.