Fieldwork: interactive re-creation

Activities using simple transportable apparatus to simulate features in the field

Try engaging your pupils in discussion about features seen in rock exposures by asking them how they could be re-created at the site – and then following their advice to reproduce the features they have seen.

Below is a detailed description of how the 'interactive re-creation' of bedding might be carried out in the field. This is followed by briefer descriptions of how to simulate lamination, cross bedding, asymmetrical and symmetrical ripple marks, fold and fault structures and shelly limestone-formation in the field.

'Interactive re-creation' of bedding

Bedded sandstone, Crowden Quarry, Derbyshire, UK.
(Peter Kennett).

Stand in front of a bedded sequence of sediments or sedimentary rocks in the field and follow this question/answer/activity sequence.

Q. If I wanted to recreate this sedimentary structure here and now, what would I need?
A. Something to form the bedding in.
Get from your bag a long transparent container, such as a test tube or small measuring cylinder to act as your 'sedimentary basin'.
Q. Now what do I need?
A. Some sand.
Q. Sand of all the same colour or of different colours?
A. The bedding will be clearer if different colours are used.
Get out two small containers of different coloured sand, e.g. red and yellow sand.
Q. What do I need to do now to produce bedding?
A. Pour small amounts of sand into the container, with alternating colours.
Q. Fine – that would work, but it wouldn't produce bedding in the same way as in this exposure of bedding. What is the 'missing ingredient'?
A. Water.
Ask the pupils if they have any water you could use, if not, get a bottle from your bag. Add the water to nearly fill the container, then small amounts of the different coloured sand at intervals to form clear beds.
Q. Would I still have formed beds if I had just used small amounts of the red-coloured sand, added at intervals?
A. Yes.
Q. Would you be able to see the different beds?
A. No.
Q. So, why is it in the bedding we can see in the sediments/rocks here, that the different beds of similar-coloured sand are clear?
You might have to help pupils towards this answer – that when each bed forms, it may have slightly different grain-sizes from bottom to top and will have packed down (consolidated) a little before the next bed is added; this means that each bed has slightly different properties from those above and below, allowing individual beds often to be clearly seen in exposures.

Bedding re-created in front of bedded rocks, Triassic sandstone near Sully, South Wales. (*Peter Kennett*).

Interactive re-creation of lamination

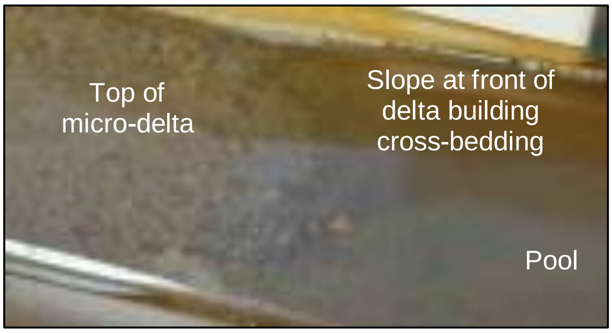
In front of an exposure of laminated mud or mudstone, ask the pupils how you could 're-create' a laminated mud sequence.

Guided by the pupils, add powdered dry clay to water in a small container with a lid (such as a jam jar), shake the container and allow one lamina of mud to settle. Ask them how long it would take for all the clay to settle; the answer is probably 'several days'. Point out that there may not have been several days available for the laminae in the nearby mud/mudstone to have formed, and that there is a key 'missing ingredient'. The 'missing ingredient' for marine mudstones (the most common type) is salt, since the salt causes the very fine clay particles to flocculate together (clump together because of the ionic effect of the salt in the water) and so become larger and settle more quickly. You could try re-creating this in a second container, and asking how much salt should be added (normal sea water is 3.5% salt). Experience shows that it is not possible to see the difference between the settling rates in the two containers in the field – a longer time would be needed to show a difference.

Clay particles flocculating in salt water on a Triassic mudstone surface near Sully, South Wales. *(Peter Kennett).*

Interactive re-creation of cross-bedding
Re-create cross-bedding in a long rectangular container nearly filled with sand, tilted on a wooden block. Pour water from a bottle onto the sand at the top. Water (and sediment) will flow down to form a pool at the lower end, and the sediment will build out into the pool as a micro-delta. The delta-front is formed of dipping cross beds. A larger-scale version of this activity is described in the Earthlearningidea, '*Mighty river in a small gutter'* whilst the formation of cross-bedding is further discussed in the Earthlearningideas, '*Sedimentary structures – cross-bedding and ancient currents'* and '*What was it like to be there? – clues in sediment which bring an environment to life'.*

The long container used to 're-create' cross bedding in front of a cross-bedded sandstone, Triassic, near Sully, South Wales *(Peter Kennett).*



Cross-bedding forming at the front of a micro-delta building across a pool in a long container. *(Peter Kennett).*

Interactive re-creation of ripple marks
To re-create ripple marks, you will need a circular container such as a plastic washbowl, or preferably a plastic cake-container, with a lid. Stick a plastic 1 litre beaker, or similar in the centre with Blu Tac™ or modelling clay. Fill the central container with water to keep it steady, and half-fill the remainder of the circular container with water. Sprinkle dry sand to form a thin layer over the bottom of the circular channel you have created. By stirring the water in the channel slowly but steadily with a dessert spoon (keeping the spoon above the sand) you will form asymmetrical ripple marks in the sand in a galaxy-like form. Each 'arm' is a ripple mark dipping more steeply down-current and less steeply up current – showing that the shapes of ancient asymmetrical ripples can be used to show the directions of the currents that formed them. This is a field version of the Earthlearningidea, *'Sand ripple marks in a washbowl: how asymmetrical ripple marks form in sand'.*

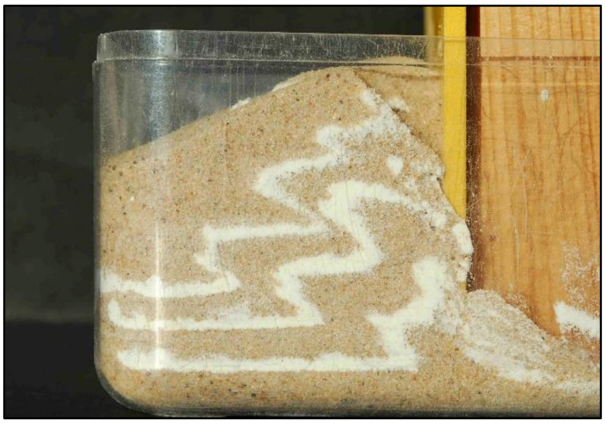
Asymmetrical ripple marks re-created by stirring of a circular container on top of an asymmetrically ripple-marked Triassic sandstone, near Sully, South Wales. Asymmetrical ripple marks can be curved, as in the container, or straight, as in the sandstone. *(Peter Kennett).*

Then explore how symmetrical ripple marks can be formed instead, by removing the central container, spreading the sand evenly over the bottom again, and gently rocking the circular container side to side. After some seconds of gentle rocking, clear symmetrical ripple marks will form parallel to the waves on the surface of the water. The ripples are not as clear as those formed in the rectangular tank in the Earthlearningidea*, 'Sand ripple marks in a tank; how symmetrical ripple marks form in sand'*, because of the wave reflections off the sides of the circular container, but nevertheless their shapes and orientations can clearly be seen to be different from those of asymmetrical ripple marks and parallel to the wave crests. Ancient symmetrical ripple marks show wave crest trends and the likely trends of palaeo-coastlines.

Re-creation of symmetrical ripple marks in a container which has been rocked from side to side – on top of symmetrical wave-formed ripple marks in Triassic sandstone, near Sully, South Wales. *(Peter Kennett).*

Interactive re-creation of folding and reverse faulting

In front of an exposure of folded and faulted rocks, set up a small rectangular plastic container with layers of flour and sand, as described in the Earthlearningidea, '*The Himalayas in 30 seconds!*' and then move the vertical partition, producing folding and reverse faults. Compare the results to the nearby folded and faulted rocks.

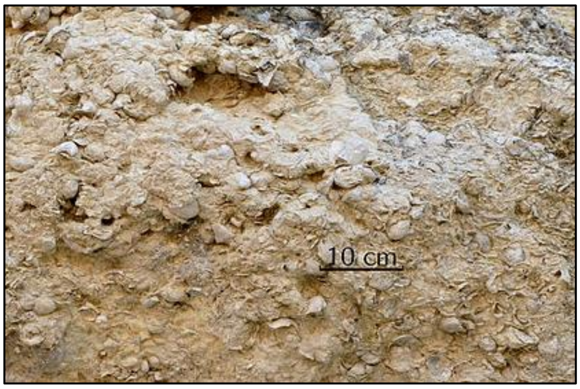


Compression in a plastic box. *(Peter Kennett*).

Folded Jurassic rocks in the Lulworth Crumple at Stair Hole, Lulworth Cove in Dorset, UK compared with a detail of the 'Compression in a plastic box' photograph.

Interactive re-creation of shelly limestone-formation

In front of a shelly limestone exposure, add some sea shells and a couple of small pebbles to a wide-necked plastic pot with a closely-fitting lid and shake vigorously for a few seconds. Pour out the results, being careful not to breathe in any dust, and compare them with the shelly limestone. If the limestone is a 'death assemblage' of broken up shells, it will be similar to your broken shell collection, but if it is a 'life assemblage' of shells preserved where they lived (and died) the differences should be clear.



Shelly limestone 'death assemblage' at Suzac, Meschers-sur-Gironde, Charente-Maritime, France.

Shell-shaker in action. *(Elizabeth Devon).*

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The back up

Title: Fieldwork: interactive re-creation

Subtitle: Activities using simple transportable apparatus to simulate features in the field

Topic: A series of interactive demonstrations in the field to simulate geological features seen in the field.

Age range of pupils: 8-80 years

Time needed to complete activity: about 10 minutes for each activity

Pupil learning outcomes: Pupils can:

- use field demonstrations to describe and explain how the related rock features formed.

Context:
This Earthlearningidea takes the notion that if geological features seen in the field can be 're-created' (simulated) in front of the exposure where they are found, with pupils in an interactive way, then pupil understanding will be enhanced. This seems to be effective, if the views of professional geologists who have worked on the relevant formations, are to be believed, when they have responded "Well - I hadn't thought of that aspect before".

Remember to carry out a risk assessment before taking anybody to any rock exposure.

Following up the activity:
Try using the 'Questions for any rock face' and other fieldwork Earthlearningideas.

Underlying principles:
- Features seen in rocks can be simulated using simple apparatus to provide insights into how the features formed.
- The flocculation of clay particles, described in the 'Interactive re-creation of lamination' section above, resulting from the ionic effect of the salt in sea water, occurs because clay particles have a lot of water molecules attached to them. In the presence of ions e.g. $Na+$ and Cl^-, this causes competition for water molecules resulting in dehydration of the clay particles and causing the particles to agglomerate together. This is commonly called 'salting out'.

Thinking skill development:
By conducting these activities in interactive ways with your pupils, you are carrying out a joint construction activity, which is then bridged to the reality of the nearby rocks. The questions provide cognitive conflict when the answers are not obvious.

Resource list:
- a bag or rucksack to carry the following apparatus and materials, and keep them hidden from the pupils until needed

Bedding
- a long transparent container such as a test tube or small measuring cylinder (e.g. a 10ml transparent plastic cylinder - unbreakable)
- two small containers of sand of different colours (e.g. red and yellow sand in old plastic film containers)
- small bottle of water, to nearly fill tube

Lamination
- small transparent container with lid, e.g. jam jar
- powdered clay in small container e.g. old plastic film container
- small bottle of water, to fill container
- optional: an additional container, more water, small container of salt (NaCl)

Cross-bedding
- long rectangular container nearly filled with washed sand, with lid
- wooden block
- 1l bottle of water

Ripple marks
- circular plastic container such as a washbowl or a circular plastic cake container with lid
- 1l plastic beaker
- enough Blu Tac™ or modelling clay to fix the plastic beaker in the centre of the circular container
- dessert spoon
- enough dry sand to form a thin layer over the bottom of the channel
- 1l bottle of water

Folding and reverse faulting
- a pre-prepared rectangular plastic container (e.g. Ferrero Rocher chocolate box or a component drawer) with layers of sand and flour
- solid partition to fit box
- polystyrene blocks to fit inside the box to help to transport it without disrupting the layers

Shelly limestone-formation
- a variety of expendable shells, of varying resistance to erosion by shaking
- a strong plastic pot with a closely-fitting lid and a wide enough neck to take the shells
- a few small pebbles
- something to pour the results onto (e.g. a clipboard)

Source: Chris King of the Earthlearningidea Team.