

Swiss roll surgery

Investigating geological structures and their outcrops using sponge rolls

There are many places in the world where spectacular folded and faulted rocks can be seen, as in the photo below.



Ladies Cave anticline, Saundersfoot, Pembrokeshire
Peter Kennett

To interpret these folds and recognise their outcrops on the ground and on maps, geologists need to be able to describe them accurately. Some of the key description words are shown in the 'Key words' table opposite.

Divide the pupils into small groups and give each group a sponge roll on a tray, a knife and a copy of the key words they should use.

Ask the pupils to:-

(1) Folded rocks

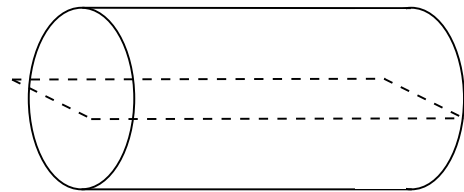
- Cut the roll in half along its length, as shown opposite.
- Draw and label one half as an anticline and the other half as a syncline.
- Using the key words, label as many features as possible.
- Label the oldest (first laid down) and youngest (last laid down) beds, (assuming the layers of sponge are rocks).

(2) Plunging folds

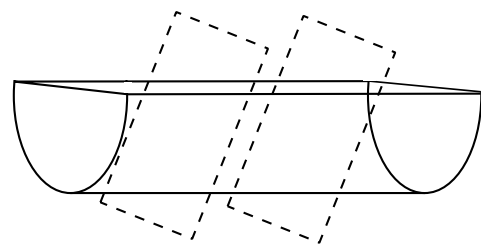
- Cut one half of the sponge at an angle in two places as shown opposite.
- Now rotate the sponge until the lower cut surface is horizontal. This shows a plunging syncline. Turn the piece over to show a plunging anticline.
- Draw how both the syncline and anticline appear as outcrops on the surface. Label as many features as possible.

| Key words | | |
|--------------|-------------------|---------------|
| Folds | | Faults |
| anticline | axial plane | fault plane |
| syncline | axial plane trace | throw |
| fold axis | limb | |
| hinge | core | |
| hinge line | | |

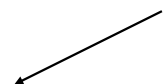
(1) Folded rocks



(2) Plunging folds

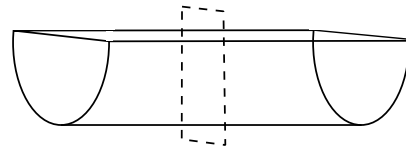
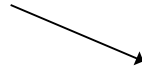


Plunging syncline;
arrow shows
direction of plunge





Plunging anticline;
arrow shows
direction of plunge



(3) Faulted rocks

Cut the other half of the roll in two vertically, as shown opposite.

- Off-set one side higher than the other (faulted) and then cut off the top horizontally until level (erosion).
- Now draw the outcrop pattern of a vertically faulted syncline after it has been eroded.
- How does the width of the beds change across the fault?
- Can you draw the same for an anticline?
- Can you imagine this for a faulted, plunging anticline and syncline? Draw them. You may find you need another sponge roll to do these.
- Now eat the geology!



Faulted syncline



Eroded faulted syncline

Swiss roll photos Elizabeth Devon

The back up

Title: Swiss roll surgery

Subtitle: Investigating geological structures and their outcrops using sponge rolls

Topic: This activity can be used in any science or geography lesson when folded and faulted rocks are discussed. By adapting the terminology, it can be used with any age group when explanations of folded and faulted rocks are required.

Age range of pupils: any age! (mentioned above)

Time needed to complete activity: 30 minutes

Pupil learning outcomes: Pupils can:

- describe up-folds and down-folds in rocks;
- explain that the oldest rocks are on the inside of an anticline;
- explain that the youngest rocks are on the inside of a syncline;
- describe how the rocks in plunging folds will appear on the ground or on a map;
- describe faulted rocks in a syncline and an anticline;
- explain how the width of the outcrops in an eroded, faulted syncline and anticline changes.

Context: Some definitions of the key words are as follows:-

Folds

anticline - up-fold in a series of rocks;

syncline - down-fold in a series of rocks;

fold axis - a line on the folded surface parallel to the hinge line;

hinge - where the rocks are most strongly bent;

hinge line - the line joining points of maximum bending;

axial plane - the plane that bisects the angle between the two limbs of a fold;

axial plane trace - the axial plane intersects the fold along a line at the top of the structure or on a geological map of the structure; the line of intersection is known as the axial plane trace because the line can be 'traced' or 'drawn' on the folded bed or map. On a simple upright fold, the trace of the axial plane is a horizontal line or a straight line on a map;

limb - area of usually dipping rocks between the hinges;

core - the rocks in the centre of the fold.

Note: It is only possible to label the oldest and youngest beds in a fold if you know that the rock sequence has not been turned upside down by great

tectonic forces. If you don't know whether or not a sequence has been inverted, then synclines should be called synforms, and anticlines, antiforms, whilst which beds are oldest and which are youngest, is unknown.

Faults

fault plane - plane along which the two sides moved;
throw - vertical displacement of rocks caused by the fault.

Following up the activity:

Earthlearningideas

<http://www.earthlearningidea.com>

'Banana benders'

'Himalayas in 30 seconds'

'Margarine mountain building'

Use an internet search engine to find images of folded and faulted rocks. These could be downloaded and labelled.

Underlying principles:

- In sequences of rocks that have not been turned upside down by tectonic forces, up-folds are called anticlines, and down-folds, synclines.
- In rock sequences that may or may not have been turned upside down by tectonic forces, up-folds are called antiforms and down-folds synforms.
- The oldest rock is always in the centre of an anticline.
- The youngest rock is always in the centre of a syncline.
- Folded rocks with curved outcrops on flat, ground surfaces or on horizontal ground surfaces on maps, indicate a plunging fold.
- If the oldest rocks are on the outside of the curves then the plunge is towards the centre of the curves and the fold is a plunging syncline.
- If the oldest rocks are on the inside of the curves, then the plunge is away from the centre of the curves and the fold is a plunging anticline.
- After faulting and erosion, the beds appear to be closer together on the upthrown side of the fault.

Thinking skill development:

Discussion of the results in groups involves metacognition. Although the sponge roll appears to show up-folds and down-folds, these have not been produced by compression in the same way as they are in the Earth; this causes cognitive conflict. Relating the cut sponge rolls to real folded and faulted rocks is a bridging skill.

Resource list:

- sponge rolls - one per group
- trays - one per group
- knives
- paper and pencils

Useful links:

<http://www.rsc.org/Education/Teachers/Resources/jes/ei/folding/index>.

Source: Developed by Elizabeth Devon from ideas presented at Earth Science Teachers' Association Conferences by Dave Turner and Chris Bedford.

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