# Picturing tectonic structures – 2 folding
## Visualise and draw fold structures from a verbal description

Encourage pupils to look carefully at fold structures and to describe them verbally so that another person can visualise them from the description.

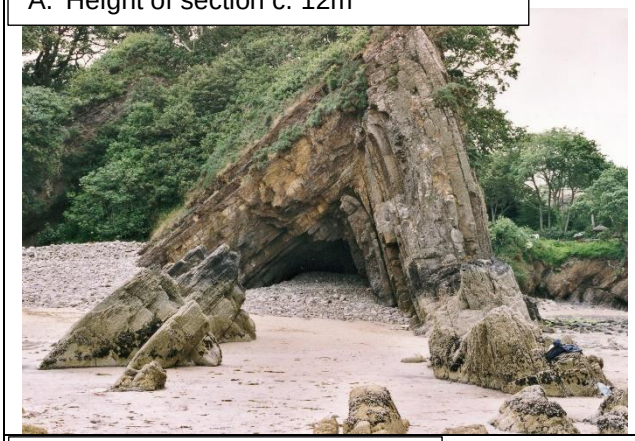
Seat pupils in pairs, with each person holding half of the photograph cards showing a variety of fold structures at different scales, printed off from those shown below. They should NOT show each other what cards they have in their hands.

Pupil A then examines one photograph and describes it as fully as possible to Pupil B, who listens carefully and then tries to draw it. Pupil B must listen in silence and not ask any questions. Pupil B then takes a turn with another card, with Pupil A doing the drawing, also in silence. They may tell their partner that all the photographs are of geological exposures at various scales. In each case, students should use as simple terms as possible to describe the fold at first. Pupils should then compare their hand-drawn efforts with the photographs.

This first round should be tried without any guidance. Then give each participant the Prompt Card, to encourage them to be more specific in further descriptions, and ask them to work through the remaining photographs, comparing their drawings with the photographs after each round. Note that some structures may be repeated on different photographs, to encourage accurate full descriptions of each. We are using the terms 'antiform' and 'synform' rather than 'anticline' and syncline' since it is impossible to be sure of the relative ages of the strata from the photographs alone.

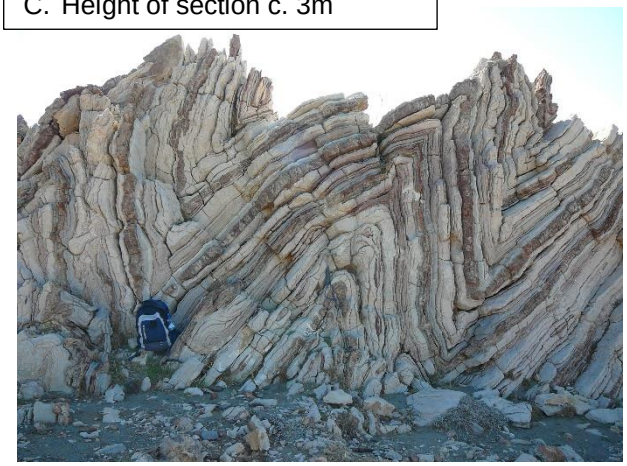
When all have finished, give out the descriptive cards and ask pupils to match the descriptions to the photographs which they have been using.

A. Height of section c. 12m



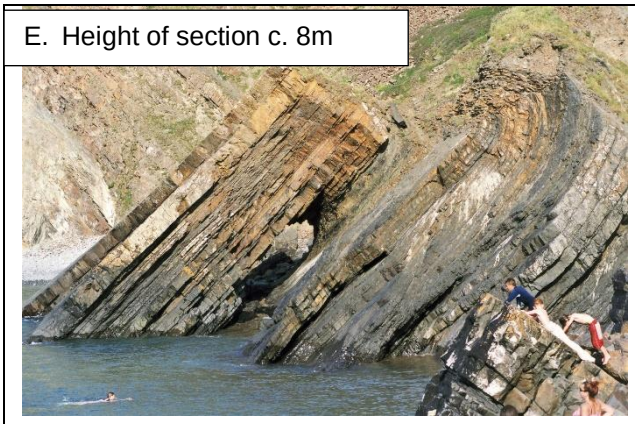
B. Height of section c. 2m

C. Height of section c. 3m



D. Height of section c.12m

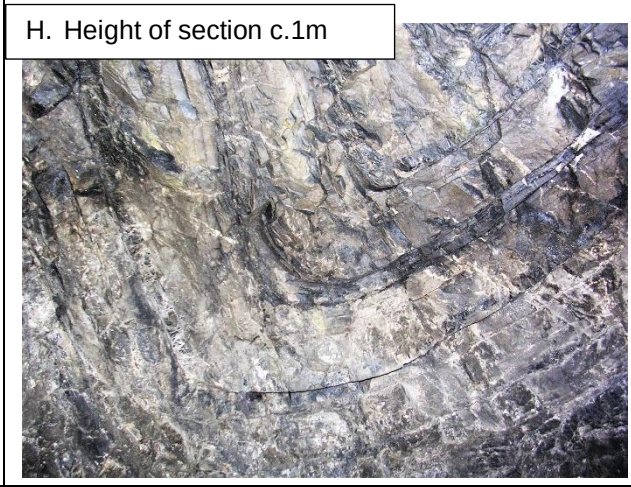
E. Height of section c. 8m



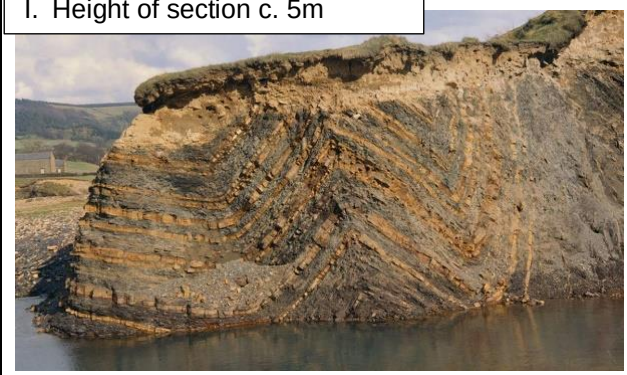
F. Height of cliffs c. 25m

G. Width of foreground c. 5m

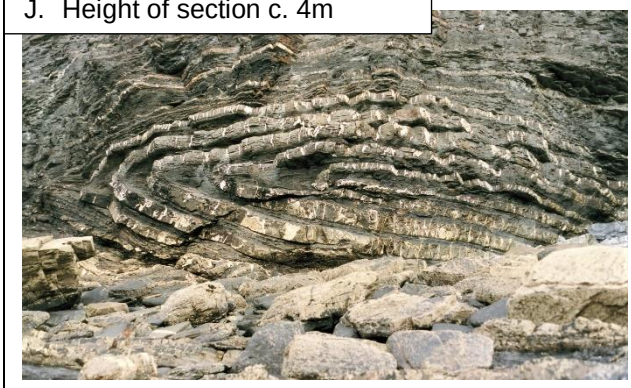
H. Height of section c.1m



I. Height of section c. 5m



J. Height of section c. 4m



K. Person is 1.8m tall

L. Height of cliffs c. 70m

**Prompt Card**
*Use this card as a check list to aid your verbal description of your photographs to your partner.*
Does the photo show one fold, or several?
Is the fold an antiform ('upfold') or synform ('downfold')
What is the attitude of the fold (i.e. is the axial plane: upright, inclined, overturned or recumbent)?
What is the hinge shape (rounded, angular)?
How tight is the fold, judged on the interlimb angle (open, tight, isoclinal)?
Does the fold plunge (i.e. the fold axis is not horizontal) and in which direction?
Estimate the size of the fold (wavelength; amplitude i.e. half the wave height)

**Descriptions of the photographs**

| | |
|---|---|
| 1. Apes Tor, Ecton, North Staffordshire. A synform/antiform pair. The folds are open, rounded, inclined, plunging gently towards the viewer, although this may not be obvious. Amplitude about 3m. Wavelength not measurable, since a complete crest-to-crest structure is not covered by the photo. | 7. Underground in Ecton Copper Mine, North Staffordshire. An upright synform/antiform pair, with a tight crest and trough, and some thickening of the less competent darker beds at these locations. Amplitude about 0.75m. Wavelength not measurable, since a complete crest-to-crest structure is not covered by the photo. |
| 2. Crackington Haven, Devon. A recumbent, isoclinal fold. The less competent shale beds have been squeezed into the crests of the folds and the more competent beds have been fractured in many places, later filled in with white minerals. | 8. Hartland Point, Devon. An isoclinal, overturned antiform, with a rounded, open hinge line. The background shows beds dipping less steeply to the right, possibly forming a synform junction with the foreground beds, or maybe a fault. |
| 3. Saundersfoot, Pembrokeshire, Wales. An inclined antiform, with a tight, angular crest. Erosion has affected the core of the antiform more than the limbs, probably because the core was composed of weaker rock than the envelope. There would also have been more stretching and fracturing around the crest. | 9. Lizard, Cornwall. A recumbent fold with open, rounded hinge line, affected by a 'break thrust', when plastic deformation was overcome by brittle failure. The dip of the fault plane is about $20^{o}$ to the right. Matching the massive bed above the figure to the one to the right of his feet suggests displacement along the fault plane of at least 4m. |
| 4. Crete. A series of antiforms and synforms, which are inclined, tight and angular. The wavelength is about 2.5 m and the amplitude about 1m. | 10. Manorbier, Pembrokeshire, Wales. Vertical beds, presumably forming one limb of a fold, but with no sign of another within the confines of the photograph. |
| 5. Underground in Ecton Copper Mine, North Staffordshire. An inclined synform with open, rounded trough. The beds alternate between limestone and chert and show little sign of change in thickness around the trough. | 11. Rowlee Bridge, Derwent, Derbyshire. A synform and an antiform, passing into a monocline on the left of the photograph. These folds are not produced by the usual tectonic forces. They lie in the bottom of a deep valley, where millions of tonnes of overlying rock have been eroded away. As the weight lessened, so the weak shales were squeezed up by the weight of the remaining valley sides, and became folded. This process is known as valley bulging. |
| 6. Crackington Haven, Devon. Zig-zag folds, i.e. a succession of tight, angular antiforms and synforms, lying recumbently with their axial planes being horizontal. Wavelength about 14m and amplitude about 7m. | 12. Cocklawburn, Northumberland. The middle ground is occupied by a rounded, open antiform plunging towards the viewer at about $10^{o}$. There appears to be a very tight plunging synform in the gully with another antiform on the right side of the photograph. |

## The back up

**Title:** Picturing tectonic structures – 2 folding

**Sub-title**: Visualise and draw fold structures from a verbal description

**Topic:** Enhancing pupils' skills of description and interpretation using photographs of folded rocks at various scales

**Age range of pupils:** 16 years upwards

**Time needed to complete activity**: About 30 minutes, depending on depth of discussion

**Pupil learning outcomes:** Pupils can:
- examine photographs of folds carefully and describe them intelligibly;
- listen carefully to a verbal description and interpret it in a drawing;
- demonstrate their understanding of the nature and origin of folding.
- enhance their observational skills as a prelude to field work.

**Context:** This could form a useful revision activity, once pupils have studied tectonic structures. Answers to the matching exercise are:

| | | | | | |
|---|---|---|---|---|---|
| A3 | B7 | C4 | D1 | E8 | F10 |
| G12 | H5 | I11 | J2 | K9 | L6 |

**Following up the activity:**
- Ensure that pupils use the same careful description and interpretation approach to geology in the field.

**Underlying principles:**
- This strategy provides training in careful observation and interpretation of all relevant features.
- Being obliged to give a verbal description encourages careful observation, to ensure that clues are not missed.

**Thinking skill development:**
Verbal dexterity and metacognition are encouraged by the need to give intelligible verbal descriptions and to interpret from them**.** Mental patterns are constructed of folding. Applying the activity to the field situation is a bridging activity.

**Resource list:**
- card sets of Photographs, Prompt Cards and Description Cards, cut out from those shown above.
- a ruler and protractor per pair might encourage accurate observation and description.

**Useful links:**
https://www.earthlearningidea.com/PDF/296_Plunging_folds_hands.pdf
https://www.earthlearningidea.com/PDF/291_Folding_hands.pdf
https://www.earthlearningidea.com/PDF/401_Picturing_faults.pdf
See the table below for other Earthlearningidea activities in the “Picturing” series.

**Source:** Written by Peter Kennett of the Earthlearningidea Team. Photos C – P. Loader; G – A. Tymon, I - © BGS P006233, L – J. Kay. All other photos by P. Kennett.

**Picturing……**

Earthlearningidea has compiled a series of activities involving examination of photographs of geological interest and their careful verbal description to others. This table will be updated as fresh activities are added. All titles begin with: “Picturing……”

| Title | Sub-title |
|---|---|
| Puzzle structures | Visualise and draw sedimentary structures from a verbal description |
| Trace fossils and other strange shapes | Visualise and draw trace fossils and sedimentary structures from a verbal description |
| Igneous rocks – 1 | Visualise and draw igneous rocks from a verbal description |
| Igneous rocks – 2 | Visualise and draw igneous rocks from a verbal description |
| Metamorphic rocks | Visualise and draw metamorphic rocks from a verbal description |
| Tectonic structures – 1 faulting | Visualise and draw fault structures from a verbal description |
| Tectonic structures – 2 folding | Visualise and draw fold structures from a verbal description |
| Minerals -1 | Visualise and draw minerals from a verbal description |
| Minerals -2 | Visualise and draw minerals from a verbal description |
| Fossils -1 | Visualise and draw fossils from a verbal description |
| Fossils -2 | Visualise and draw fossils from a verbal description |
| Landforms 1 | Visualise and draw landforms from a verbal description |
| Landforms 2 | Visualise and draw landforms from a verbal description |