# Geological mapwork from scratch 2: valley with simple geology
## Draw your own cross sections and 3D geological model

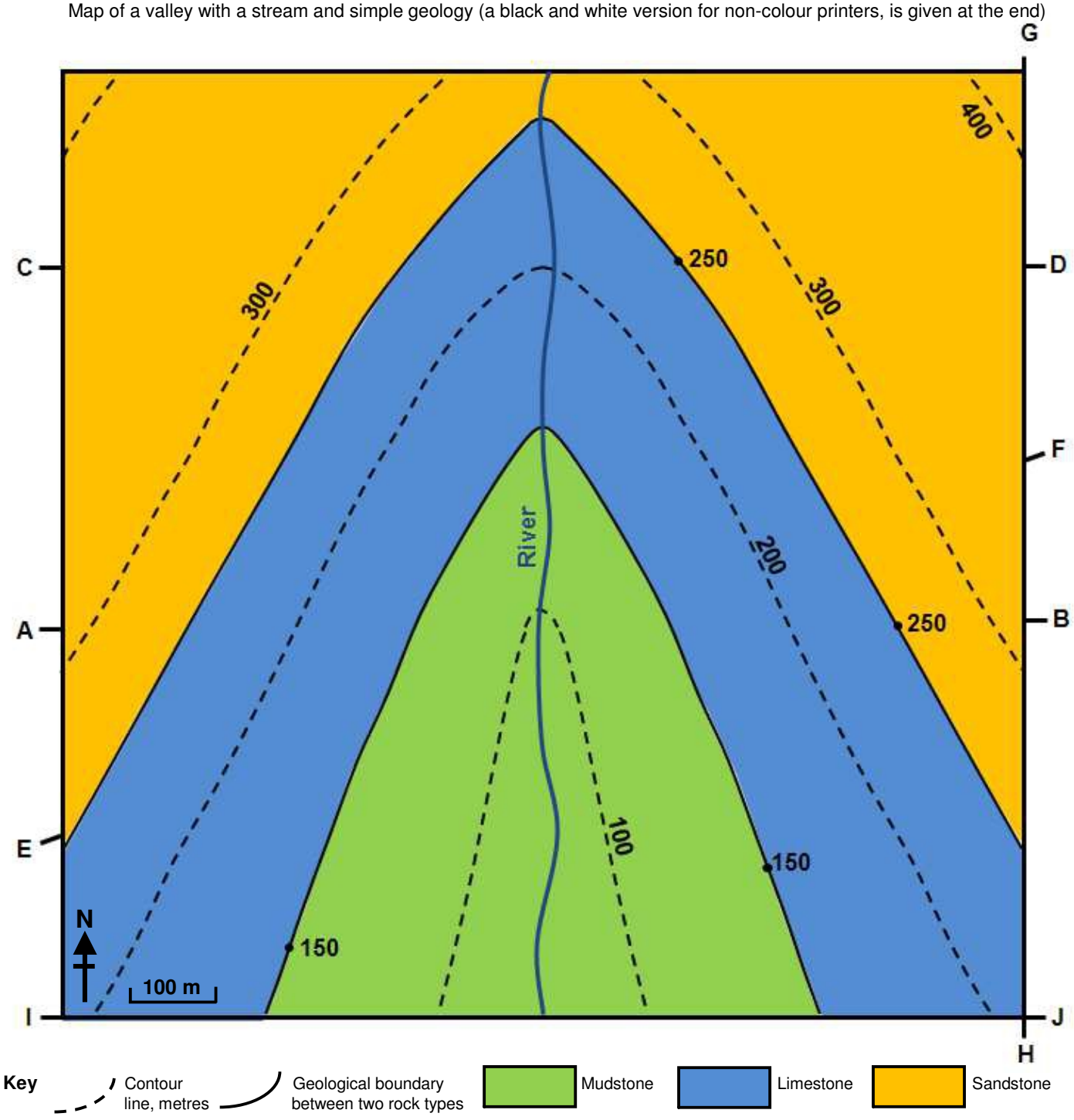
A valley with a stream looks like this:



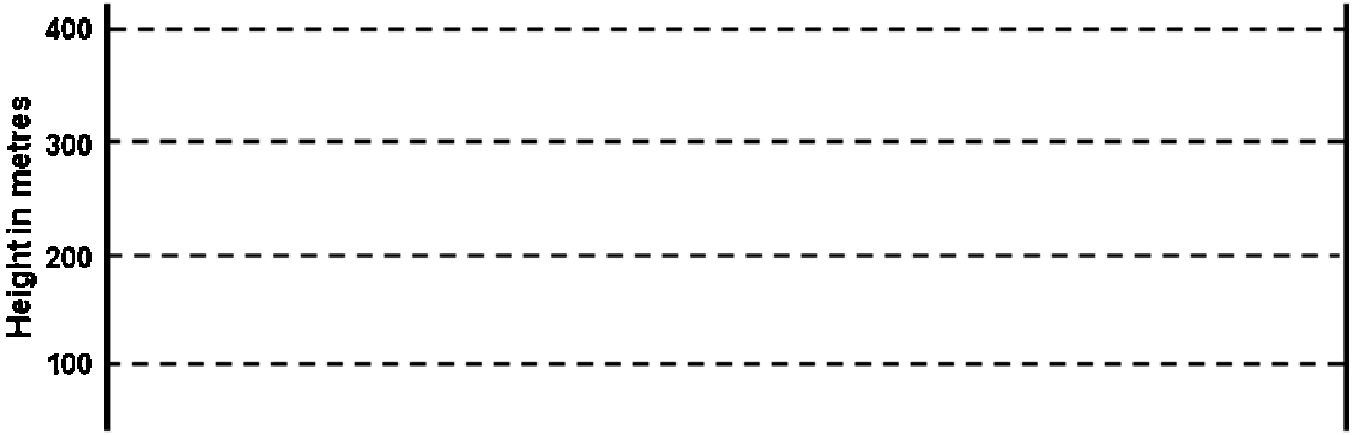
For the map of a valley below, which has simple geology, draw geological cross sections, A –B, C–D, E–F, G–H and I–J. Use cross section profiles like the one given on the next page, drawn to the right lengths.

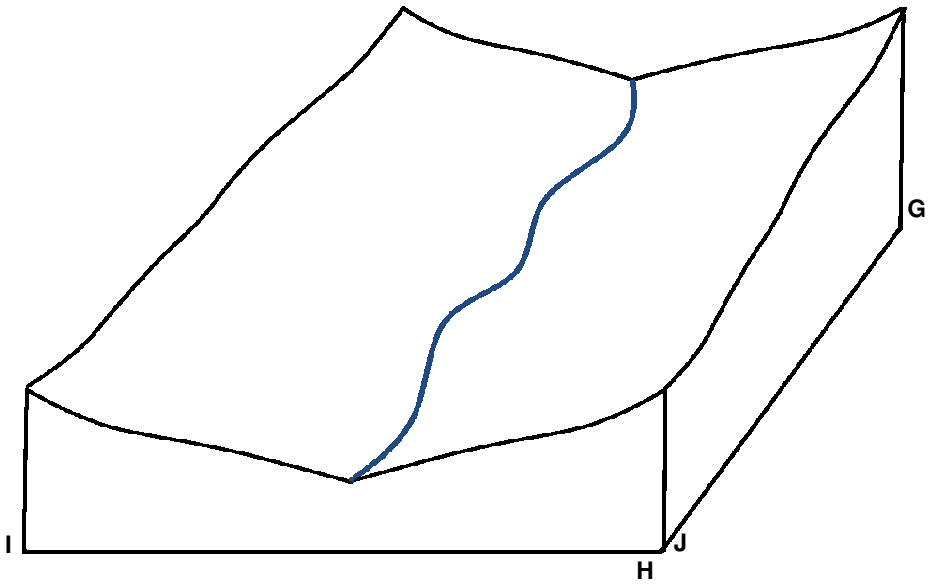
Then use cross sections G–H and I–J and the map to sketch the geology onto the 3D block diagram on the next page – to show the 3D geology of the area.

Map of a valley with a stream and simple geology (a black and white version for non-colour printers, is given at the end)



Blank topographic profile (horizontal scale equals vertical scale)




3D block diagram of the map area

.....

## The back up

**Title:** Geological mapwork from scratch 2: valley with simple geology

**Subtitle:** Draw your own cross sections and 3D geological model

**Topic:** Part of a series introducing simple geological mapwork. A table of the progression and spiralling of spatial thinking skills involved through the series is given on the final page.

**Age range of pupils:** 14 – 19 years

**Time needed to complete activity**: 45 mins

**Pupil learning outcomes:** Pupils can:

- use contours to draw topographical profiles;
- add geological boundaries to topographical profiles to produce cross sections of geological maps;
- sketch geology onto 3D block diagrams;
- use the exercise to understand three dimensional topography and how it interacts with three dimensional geology.

**Context:**
Pupils are shown a photograph of a straight valley, a simple landform, They are given a very simple geological map of such a landform, with horizontal beds. They are asked to draw topographical cross sections of the valley, adding the geology to produce geological cross sections. As the cross-section drawing progresses, it involves more interpolation and more three-dimensional thinking skills. Pupils will realise that all the geological boundaries and therefore all the beds are horizontal. This will allow them to complete the 3D block diagram successfully.

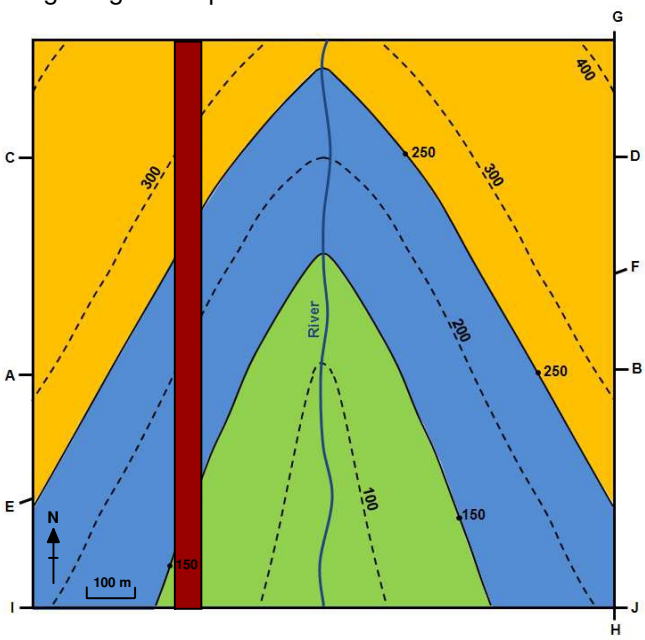
**Following up the activity:**
Pupils could be asked, if there were a rock exposure in the valley, what the dip of the beds would be, and so which of these symbols would be most appropriate to add to the geological map:

+ horizontal beds

┼ vertical beds (longest line parallel to the bedding)

→ 30° direction of dip (arrow direction) and amount of dip (in degrees from the horizontal of the beds)

Try adding a North-South trending, 50 metre wide, vertical dyke of microgranite to the map, as shown below. Ask the pupils to add this to the appropriate cross sections. This will help them to begin to understand how vertical features appear on geological maps and cross sections.




Ask pupils to make a block model of the area, using coloured modelling clay. Then it is very easy to add the dyke, by simply cutting the model at the correct place, and adding a vertical sheet of coloured clay.

**Underlying principles:**

- A simple way to show the relief of a topographical map is to use the contours to draw a cross section of the area.
- Geological boundaries can be added to such topographical cross sections, to show the three dimensional geological structure.
- When beds are horizontal, their boundaries follow the contours at the appropriate height.
- When geological features are vertical, they cut across the topography, the map and the cross sections in straight lines.

**Thinking skill development:**

The drawing of topographical and geological cross sections involves spatial thinking skills. The more complex the cross sections become, the more spatial interpretation is needed, including interpolation and extrapolation skills.

**Resource list:**

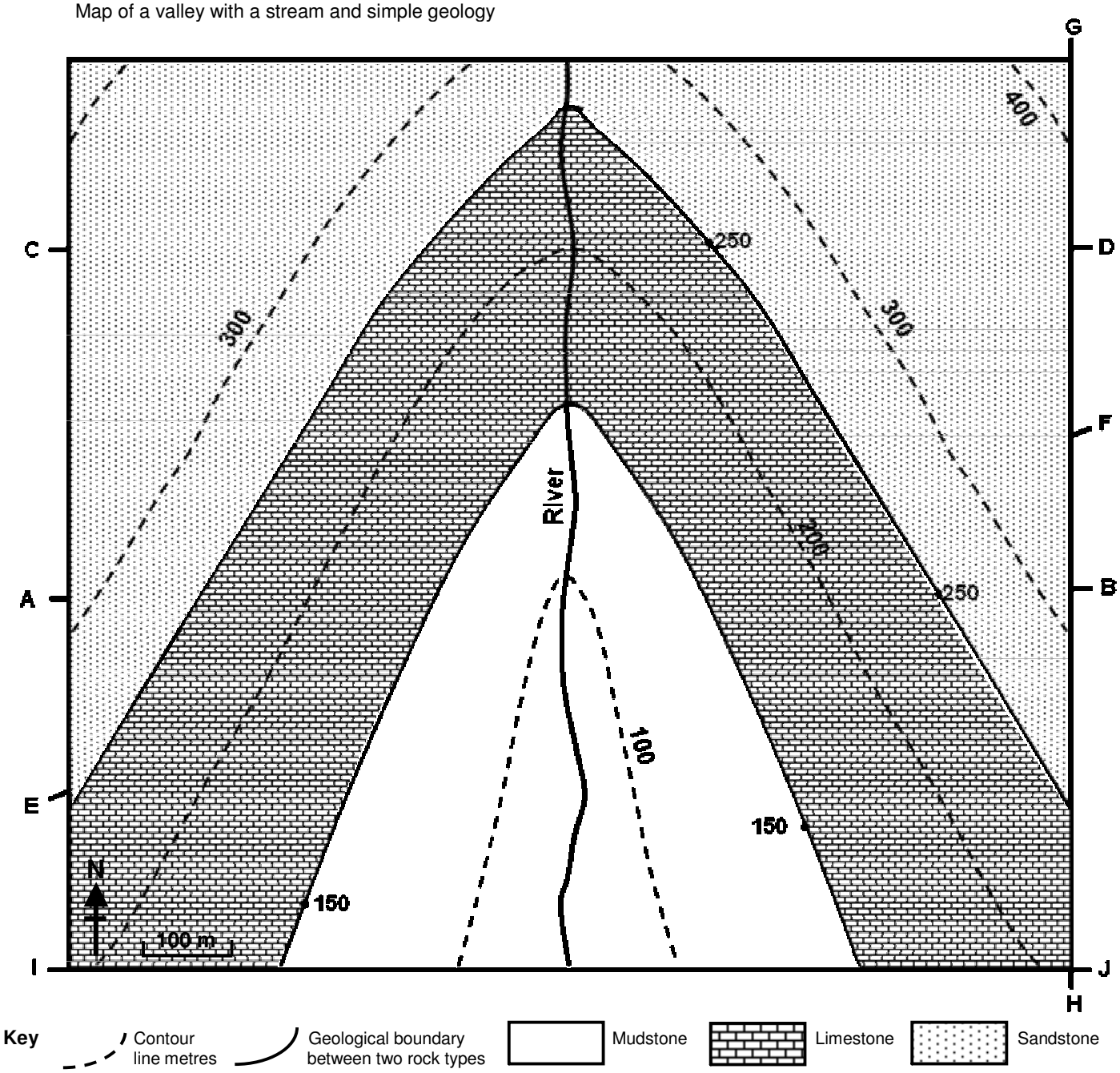
- a print off of the map and blank topographic profile, per pupil
- drawing materials, including pencil, eraser, ruler and pencil crayons

**Useful links:**

Higher level mapwork exercises with online tutorials are available for free download from the Open University: http://podcast.open.ac.uk/oulearn/science/podcast-s260_mapwork#

**Source:** This is the second of a series of simple introductory geological map exercises developed by Joe Crossley and Joe Whitehead. Part I of this series of exercises (from which this exercise comes) was published in '*Geology Teaching*' the journal of the Association of Teachers of Geology in 1979 (Volume 4, No. 2, pages 56 – 61).

Map of a valley with a stream and simple geology



## The progression and spiralling of spatial thinking skills shown by the Earthlearningidea 'Geological mapwork from scratch' exercises and the 'Geological mapwork from models' exercises

| Exercise | | Topographic surface | Geological surfaces | Strategies and skills |
|---|---|---|---|---|
| Mapwork from scratch 1: a conical hill | | Conical hill | Flat and horizontal | • Plot and draw simple topographic cross sections<br>• Add geological boundary intersections and join with straight, horizontal lines |
| Mapwork from scratch 2: valley with simple geology | | Sloping valley | Flat and horizontal | • Plot and draw simple topographic cross sections<br>• Add geological boundary intersections and join with straight, horizontal lines<br>• Sketch geology onto a 3D block diagram |
| Mapwork from scratch 3: valley with dipping geology | | Sloping valley | Dipping surfaces | • Draw true dip on a cross section using a protractor<br>• Add geological boundary intersections and join with straight lines<br>• Appreciate that apparent dip is always less than true dip<br>• Appreciate that, in valleys, geological boundaries usually 'V' in the direction of dip.<br>• Sketch geology onto a 3D block diagram<br>• Begin to compile a list of mapwork rules |
| Mapwork from models 1 | Plain version 1 | Flat | Flat and horizontal | • Add geological boundary data to cross sections and join with straight, horizontal lines |
| | Plain version 2 | Flat | Dipping surfaces; vertical feature | • Add geological boundary data to cross sections and join with straight lines<br>• Use boundaries on the cross sections which intersect the topographic surface to draw a boundary on the surface<br>• Add a vertical feature (dyke) |
| Mapwork from models 2 | Cuesta version 1 | Asymmetrical ridge | Flat and horizontal | • Add geological boundary data to cross sections to construct straight, horizontal lines |
| | Cuesta version 2 | Asymmetrical ridge | Dipping surfaces; vertical feature | • Draw true dip on a cross section using a protractor<br>• Add parallel geological boundaries<br>• Add a vertical feature (fault) that moves a geological boundary<br>• Appreciate the link between tough and weak geological formations and topography |
| Mapwork from models 3: valley with horizontal floor | | Valley with horizontal floor | Dipping surfaces; vertical feature | • Draw true dip on a cross section using a protractor<br>• Add parallel geological boundaries<br>• Use boundaries on the cross sections which intersect the topographic surface to draw in boundaries on the surface<br>• Construct parallel boundaries on the surface<br>• Appreciate that, in valleys, geological boundaries usually 'V' in the direction of dip<br>• Appreciate that apparent thickness is always greater than true thickness<br>• Add a vertical feature (dyke) |
| Mapwork from models 4 | Ridge/ valley with sloping floor version 1 | Ridge/ valley with sloping floor | Dipping surfaces | • Add geological boundary data to cross sections to construct straight lines<br>• Add parallel geological boundaries<br>• Appreciate the link between tough and weak geological formations and topography<br>• Interpolate approximate true dip from apparent dip |
| | Ridge/ valley with sloping floor version 2 | Ridge/ valley with sloping floor | Dipping surfaces | • Draw true dip on a cross section using a protractor<br>• Add parallel geological boundaries to cross sections<br>• Use boundaries on the cross sections which intersect the topographic surface to draw in boundaries on the surface<br>• Construct parallel boundaries on the surface<br>• Appreciate that, in valleys, geological boundaries usually 'V' in the direction of dip and the opposite is true of ridges |
| Mapwork from models 5: plain; cuesta; valley with horizontal floor; ridge/ valley with sloping floor | | All the model landforms above | Surfaces folded into open folds | The strategies and skills described in the box above and, in addition:<br>• Identify folds with equally dipping limbs, and those with limbs dipping at different angles<br>• Appreciate inverted topography<br>• Draw fold axes and fold axial planes<br>• Draw an unconformity and a pluton with a metamorphic aureole |
| Mapwork from models 6: plain with faulted rocks 1 | | Flat | Normal and tear dip faults; dipping bedding | • Draw the effects of a normal and a tear dip fault on cross sections<br>• Use these to explain how different types of fault can have similar effects on outcrop patterns of dipping beds (but different effects of vertical features) |
| Mapwork from models 7: plain with faulted rocks 2 | | Flat | Normal and reverse strike faults; dipping bedding | • Draw the effects of normal and reverse strike faults on cross sections<br>• Use these to explain how different types of fault can have similar effects on outcrop patterns |
| Mapwork from models 8: plain with faulted rocks 3 | | Flat | Normal, reverse, thrust and strike-slip faults at 45$^{o}$ to the strike; dipping bedding | • Draw the effects of different sorts of faults on cross sections<br>• Use this to explain how different types of fault can have similar effects on outcrop patterns |
| DIY dip and strike model | | Dipping surface | Dipping bed | • Measuring dip, strike and apparent dip on a model dipping surface, using a DIY clinometer if no other clinometer is available |
| Geological mapwork: Surface geology and the geological map | | Not given, assumed fairly flat | Relatively complex | • Match surface geological features to places on a geological map where they might be found. |