Virtual Landscapes Project

Virtual Landscapes are screen-based virtual reality environments, created using the Unity 3D game engine software by a team of geologists at the School of Earth and Environment, University of Leeds, UK.

The aims of the landscapes are to:

* Enhance the training students receive in geological field and map skills prior to going in the field.
* Develop 3D visualisation skills.
* Accessible parallel provision field trips.

They are all freely available on the internet at <http://www.see.leeds.ac.uk/virtual-landscapes/>

The following are suggestions for how the different landscapes can be used in teaching.

3D Topographic map

Simple model to introduce students to working with maps

Potential questions/exercises

Look at the 2D map:

* Where are the highest and lowest points?
* How far above sea level in metres are you when standing on the highest point?
* Identify the steepest and shallowest slopes
* Draw a topographic profile and describe what you would see as you walk along it

Check out your answers in the 3D world

3D Geological maps

Simple geological maps where pressing the numerical keys the dip or strike changes by a fixed amount.

Dip version:

Same strike (090) and varying dip (keys 1-6) (0°,11°, 22°, 45°, 67°, 90°)

Strike version:

Same dip (22°) and varying strike (keys 1-8) (090, 135, 180, 225, 270, 315, 360, 045)

Potential questions/exercises:

* Ask students to create their own outcrop pattern ‘rules’ using the 3D models. For example:
	+ How does varying the dip effect the apparent thickness of a unit?
	+ Compare the outcrop patterns in the valleys as strike and dip varies – what do you notice?
	+ What’s the relationship between the horizontal beds and the topographic contours?

Geological mapping landscapes

Three River Hills, Lighthouse Bay and Rhoscolyn.

Designed as in-class exercises with paper field slip and notebook, where students can “map” a virtual landscape populated with rock outcrops

Tasks: produce a geological map, cross section, stratigraphic column and field report

Lighthouse Bay

This has a simple geology with all beds dipping 090/22N. It takes 2 – 4 hours to map depending on experience.

Potential shorter/easier exercises include:

* Look at the vegetation can you identify a pattern?
* How might this help you identify the underlying geology?
* Find an outcrop in each type of vegetation. Does this confirm or disprove your theory?
* Map one boundary by walking across the area and identifying the outcrops.
* Map the boundary using strike lines (structure contours). How does it compare to the boundary you mapped?

Three River Hills

This has a more complex geology, including a syncline with an overturned and sheared out limb. It takes 1 – 3 days to map whole area depending on experience.

Potential shorter/easier exercises include:

* Map a transect along the northern river and draw the cross section
* Map the west coast to just east of the normal fault – simple geology
* Map the top third/half of the area

Rhoscolyn, Anglesey, UK

The Rhoscolyn virtual landscape is based on a real place. The topography, grid coordinates, vegetation and outcrops are as close to the real thing as we could make them.

Rhoscolyn lies on Holy Island, off the west coast of Anglesey, North Wales, UK. A thick sequence of Cambrian metasediments – psammites, pelites, and quartzites – have been folded into a large scale gently plunging asymmetric anticline with a well-developed axial planar cleavage. The competence contrast between the different units has resulted in many interesting small scale structures. These are highlighted through the use of photographs, and 3D high resolution photogrammetric models of some of the key outcrops.

The Rhoscolyn landscape can be run as a simple mapping exercise covering the eastern half of the landscape and just looking at the overall anticline structure. Alternatively, the more complex aspects of the geology can be considered by including a visit to the 3D outcrops in the west of the area where evidence for earlier deformation events can be seen in the folding of small scale structures and the development of crenulation cleavages. Many papers have been written on the area, and an exercise based round the virtual landscape could be widened to include consideration of these.

There are two different mapping slips: one covers the whole of the area; and the other covers just the eastern mapping area. Both of these slips come in versions with and without the locations of the outcrops and photos shown.

Useful info

The 3D topographic map, 3D geological maps and Lighthouse Bay landscapes should all play online on PCs or Macs. They can all be downloaded as standalone files for PCs and we are currently (April 2020) working on producing Mac compatible downloadable versions. Three River Hills and Rhoscolyn cannot be played online directly, but both can be downloaded and run on PCs. There are both PC and Mac versions available for Rhoscolyn. For Three River Hills there is a 32-bit version for Macs, but this may not work with newer operating systems. Unfortunately, a 64-bit version is not available and is not something we can produce as the version of the software used to create it is now just too old to use.

Key controls:

Mouse: direction of travel/view.

WASD or arrow keys: move forward, backward or sideways.

Space bar: jump (use with movement keys if you get stuck in a hole!).

G: GPS

C: Compass in mapping worlds or to change camera from ground to aerial view in 3D block models.

T: Switch from terrain to field slip view (Lighthouse Bay and 3D topo map).

Click on notebooks to see contents.

Click on cameras to see the view (best when looking in the same direction as the camera).

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Teach the Earth link

<https://serc.carleton.edu/teachearth/activities/197181.html>

Houghton JJ, Lloyd GE, Robinson A, Gordon CE, Morgan DJ. 2015. The Virtual Worlds Project: geological mapping and field skills. Geology Today. 227-231 31.6 <https://onlinelibrary.wiley.com/doi/abs/10.1111/gto.12117>

<http://eprints.whiterose.ac.uk/92115/>

For more information on the inclusive Access Anglesey field trip for which the Rhoscolyn virtual landscape was designed.

<https://accessanglesey.leeds.ac.uk/home/publications/>