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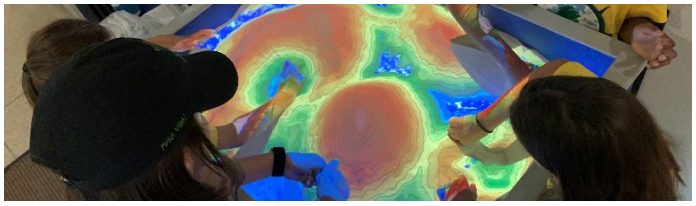
Augmented Reality (AR) Sandbox Lesson

An augmented reality (AR) sandbox is a 3D, interactive, dynamic educational tool to help understand mapping, **topography**, and **watersheds**. It was created by Oliver Kreylos, Peter Gold, and M. Burak Yikilmaz at the University of California-Davis and uses a motion sensor and computer software to project **contour lines** (lines to equal elevation) and corresponding colors onto the real-time shape of the sand.

First, make sure all students clean and dry their hands with sanitizer before touching the sand. We suggest splitting into groups of five or less and having the other students wait for their turn, ideally looking at topographic maps while they wait.



Topic – Topographic Maps

1) Ask the students what they see.
   - Build on their observations of contour lines and colors.
   - Note that the colors they are seeing are universally used to show elevations (from low to high: blue, green, yellow, orange, red). If they build a high enough mountain, the top elevation will be shown as white like a snow-capped peak.

2) Ask the students to follow the path of one contour line, either with a finger, or a pointer.
   - Does the line cross any other lines? Why not?

3) Look at areas that are steeper or flatter.
   - What do the students notice about the contour lines? Do they notice that the contour lines are closer together where the sand is steeper and farther apart where the sand is less steep (flatter)?
   - Discuss walking across a flat area vs. a steep area. Which is easier? Which takes more effort?
   - Discuss rolling a ball across the surface. Where will the ball roll faster or more slowly? Why?

Topic – Landforms

1) Next, ask the students to build a steep mountain, a gentle mountain, a river, an island, a ridge, etc..

2) When they build a river, especially for the older kids, teach the rule of Vs (the contour lines appear to form the letter “v” which always points upstream like an arrow).

3) Make it rain on the landscape by extending your arm (cloud) about 12” over the sand with your fingers spread wide. Observe how the water flows. Have the students make their own rainfall and predict (and observe) how the water flows. Does the water flow and flood where they expected?

4) Discuss erosion. As the water flows onto the land, what will happen to the land or sediment that is weathered and transported by the water? Where will the sediment be deposited?

Topic – Watersheds

1) Build a ridge or mountain that drains in two directions – ask the students to predict where the water will flow if it rains on the ridge.

2) Ask the students to make it rain and watch the water flow in different directions – discuss the concept of a watershed.

3) Ask the students if they can build a watershed with a main river channel and smaller tributaries, or a wide floodplain.

4) Build a dam (with your hand or a piece of cardboard) – now what happens to the water?

5) Create a lake, perhaps by using the dam you just built, and ask the students how water gets into a lake, then have them build their own. Note, a spring cannot be built in this model.

6) By this point there may be a lot of water filling up the low points. Hold down the D key to drain the dark blue, flowing water, or press F to flood the lowest elevations again.

Topic – Volcanic Hazards

1) Drain (D) the water, then ask the students to work together to build a large volcano with a small crater at the top. Press (L) to switch to lava mode and ask someone to create an eruption (the same method works to make lava and rain). How does the lava flow? Are there any homes in the way? Why do you think topographic maps may be useful to predict volcanic hazard zones?

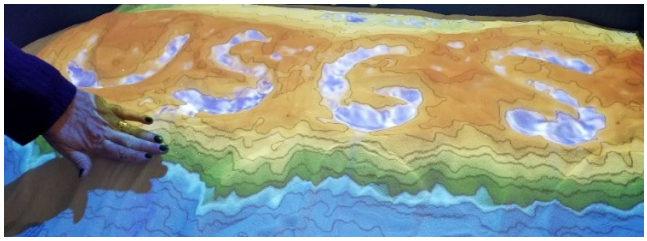
Glossary

Topography: The study of the shape of the land's surface, used to create topographic maps.

Contour lines: Lines of equal elevation on a topographic map. Contour lines never cross.

Watershed: An area of land, defined by its shape, that drains all the water toward one location.

Lidar: **Li**ght **d**etection **a**nd **r**anging. The Landsat program, a partnership between USGS and NASA, uses lidar to make detailed maps.



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UC Davis, AR sandbox software, blueprints, and additional educational resources: https://arsandbox.ucdavis.edu/