Examples of Tactile Aids for Teaching Introductory Geology Students with Visual Disabilities

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Introduction
Geology is a visually-stimulating science, and as such, presents significant challenges to students with visual disabilities. This problem is exacerbated by the explosion of visual material within introductory geoscience textbooks over the last few decades. Accessible textbooks usually do not attempt to describe this visual material in any detailed way.

I present a variety of examples illustrating the translation of complex diagrams, illustrations, visualizations, and maps into accessible products for a student with low vision enrolled in EES 202 (Principles of Physical Geology) at the University of Kentucky during the Spring semester of 2017. The course uses Marshall’s “Earth: Portrait of a Planet” as the suggested textbook, but many of the graphics and illustrations come from other sources.

With the expert assistance from the University of Kentucky’s Disability Resource Center and frequent feedback from the student, the design and implementation of the aids were gradually improved during the course of the semester. Judging from preliminary observations and student feedback, the design approach described here (in this poster for selected examples), most of the aids, particularly the larger and simpler ones, worked well to illustrate the relevant geologic concepts.

Clay models
Small clay models of volcanoes (shields, stratovolcano, dome, cinder cone, and caldera) and river channel morphologies (meandering, braided, and dendritic) were provided to the student to examine during lectures.

Student feedback: “I thought these clay models were really helpful. They let me feel the different types, and I had a three dimensional model that gave me a really good idea what they looked like.”

Block models
Two approaches for using clay models of rock formations created using clay were used to accentuate contacts on existing models, and (b) a model of plunging folds was constructed using a small cardboard box and sticky-sided foam sheets.

Student feedback: “I thought these clay models were really helpful. They let me feel the different types, and I had a three dimensional model that gave me a really good idea what they looked like.”

Fossil succession
Based on a figure from Marshak (2011), this tactile graphic uses paper and glitter-coated foam sheets saturated with plastic Braille labels to represent geologic strata. Small pieces of hardware (e.g., nails, metal washers, bolts, drywall anchors, and caps, and fold pads) to represent individual fossil species. This graphic illustrates concepts such as fossil succession, index fossil, and biostratigraphic ranges (of individual fossil species), and fossil assemblages.

Swell paper printouts
A Harper PMF (“Pictures in a Flash”) tactile image maker at the UK Disability Resource Center was used to make tactile graphics when quick turn-around was required. This printer duplicates black and white images from a regular piece of paper onto a special sheet of heat-sensitive swell paper. Labels can be added directly to the original image in 24 pt Swell Braille font (available in PowerPoint). The examples shown below are a pale lithoconic carbon and a diagram of sedimentary cross-bedding.

Enhanced raised relief topographic maps
Wikki Stix were used to add tactile information to plastic raised relief topographic maps (e.g., bounding faults of calderas, fold axes, streams, watershed boundaries, etc.). For some exercises, the student was given the enhanced map; for others, the student added the Wikki Stix to show some feature.

Student feedback: “In this lab (topographic map), I was able to do more things almost independently than any other lab. It was very straightforward and very simple to do.” The watershed boundary exercise was “effective, but a little difficult. It was easy for me to mix part of a watershed boundary in on the wrong direction—maybe was not as raised (topographically high) as I thought, or it could be that I was just a little confused on the exercise.”

Stratigraphic correlation
Principles of stratigraphic correlation, pinchouts, facies changes, and transgressive-regressive sequences were taught using tactile stratigraphic columns mounted on a cork board. The student added pushpins and string to correlate the strata.

Student feedback: “This was really good. I didn’t have any trouble with the activity. Maybe next time though, instead of the pushpins and string, you could use Wikki Stix instead. I think it might make it a little easier.”

Relative dating
Textured materials (e.g., smooth and glitter-coated foam sheets, sand paper, felt, corrugated cardboard, etc.) were used to represent rock formations on diagrams used for relative dating exercises. Faults were depicted with string or thin cord. Features were identified with plastic Braille labels and a magnitized legend which could be removed by a student with relative age on a thin metal strip.

Student feedback: “These were really helpful when the exercises were more simple, but then when they started to get more complex, it got more difficult to figure out what was going on everywhere. I don’t think there is really anything you can change or make better though, sighted people can view the whole picture at one time, which makes it easier for them, but a visually impaired person would have to feel all of these different layers one at a time. It makes it a little complicated to keep up with what goes where. Also, we need to find something that sticks to all these different textures because some of the labels started falling off.”

Flood recurrence intervals
In this graphing exercise, the student plotted peak discharge events and corresponding flood recurrence intervals using pushpins (e.g., Travis, 1990) and a sheet of raised-line semi-log graph paper mounted on a cork board. A string was used to find the approximate best-fit line through the data, allowing the student to extrapolate to find the discharge of a larger magnitude, lower-frequency event (e.g., the “100-year flood”).

Student feedback: “The exercise was easy when I had someone (sighted) there with me, but in the future I think adding Braille labels to the exercise would be helpful. I felt like the student could do it independently. But with someone’s help, it was really simple and effective when I did it.”

Recommendations for instructors

- Size: Larger aids were preferred by the student. All aids should be resolvable with a finger tip.
- Materials: Some materials worked better than others. Plastic Braille labels do not adhere well to cardboard or rough surfaces (sandpaper and some glitter-coated foam sheets).
- Design: Simpler is better.
- Preparation: Many of these aids required significant time and effort to prepare and successfully deploy, but the payoff in learning for the student was well worth it.
- Institutional support: Seek out advice, assistance, and possible funding sources available from your institution’s disability support office.
- Additional support: An adaptable teaching assistant, a sighted student who can serve as a lab partner, and frequent one-on-one meetings with the student can all help.

You can do this!

Inspirations

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