

Want Better-Prepared Students? Teach Teachers to Think Like Geoscientists

Among other courses, I teach inquiry-based, integrated lab-lecture science courses for pre-service elementary teachers with limited enrollment. As opposed to geoscience majors, this audience typically has a weak background in science and math and considerable trepidation about learning, and ultimately teaching, science and math. I also develop and teach field-based professional development geoscience courses for in-service K-12 teachers, which is an audience that has experience teaching in K-12 settings and is seeking deeper knowledge and skills. In many ways, teaching geoscience courses for teachers is quite similar to teaching courses for geoscience majors; the same challenging concepts are highlighted and all students work to gain conceptual knowledge, discipline-specific skills, and an understanding of the nature and processes of science. However, one major additional goal in geoscience courses for teachers is that learners must sufficiently and confidently master major geoscience concepts and methods in order to effectively teach geoscience.

I find that establishing a highly interactive student-centered course is critical to teaching the methods of science. Also critical are fostering mutual respect, enthusiasm for experimentation, and acceptance of failure as an important step in deep learning. In my small courses, I've found that combining science notebooks with reflective writing promotes these critical course components. My students use notebooks daily to learn and model some of the processes of science: recording data, observations and questions; building and testing hypotheses; summarizing results, etc. But they also use notebooks to identify and challenge their currently held preconceptions, build on their existing knowledge, monitor their ongoing learning and thinking about concepts or methods, and reflect on course activities and their learning progress (e.g. http://serc.carleton.edu/sp/process_of_science/examples/ref_writ_prompt.html).

Careful, standardized, and repeatable field observations, in the context of conceptual or numerical models, are the foundations for what we know about the Earth and Earth Systems (and how we know it), but my students often don't consider their observations as scientific data. Teaching students to make quality observations in the field, to find patterns in their data, and to clearly separate observations from interpretations, are important activities that result in skills that are highly transferrable to other sciences and scientific thinking in general. The related concept of multiple working hypotheses is also very difficult for many students, in part because asking scientific questions is daunting for many novices, but is key in understanding how to "think like a geologist". I think it is very important that pre- and in-service teachers have ample opportunity to make basic field observations and interpret geologic data in order to understand, use, and ultimately teach, the methods of geoscience in their own classrooms.