Engineering, Sustainability, and the Geosciences Workshop
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Navigating an Ersatz Dichotomy (Science vs Engineering)

Everyone attending this workshop already believes in integration of geosciences and engineering for students in both disciplines, and with good reason. Geological background provides engineers with understanding of context and process that is critical to engineering practice. Engineers must work with geologists, understand geologic analysis, and know when to consult a geologist in the first place. One can further easily argue that exposure to the more qualitative and abstract bits of geology rounds-out engineering students who are more used to quantitative recipes. Likewise, engineering topics can provide geology students with illustrative concrete examples and the ability to pin a number on a complex process, very useful for comparisons and decision-making. The empirical formulas that engineers routinely use can provide quick rough estimates. Often this division between engineering and the geosciences (science in general) is described as one of theory versus practice. However, there are many areas of crossover where the studies of engineers and scientists are all but indistinguishable, for example physical seismology, soils, or my own area, hydrology (hydrogeology if you are a geologist). Before diving into the merits of integration and cross-pollination, I think a moment to reflect upon the nature of this division is appropriate and necessary.

We are bumping up against the well entrenched notion that science and engineering are diametrically opposed camps (often with no love lost and a healthy dose of suspicion.) Separation of application and theory is natural in any discipline, but science and engineering are set up as near adversaries as opposed to intertwined partners that exist on a spectrum. The traditional geosciences and engineering curricula reflect this attitude of division and likely leads in no small part to student attitudes. Like small children absorbing and repeating a parents' private comment, students proclaim that they "don't need to know that" and balk—engineers at learning about general earth processes and geologists at following computational methods. I recently had this experience in an engineering class—surface water hydrology—in which one class period was spent discussing atmospheric processes that lead to precipitation. The students complained that the material was not engineering and therefore they should not have to know it, despite the fact that we were relating the processes to resulting precipitation patterns (and thus significant runoff patterns.)

As someone who straddles the geosciences/environmental engineering divide (without changing much at all), I frequently find myself swapping sides in a way that feels much like what anthropologists call code-switching: adapting ones language and social behavior when moving between cultures. In my dual-role as instructor in an engineering department and in a geology department at a different institution, I sometimes simultaneously teach the same material but, carefully, employ a different vocabulary. This also means I hear my geology colleagues' dismissive attitude toward engineering as an engineer, and vice versa. Until we are able to address this prejudice on both sides of the divide, we cannot expect students to embrace ideas that feel alien and that they are being taught to treat with suspicion.

That said, as instructor I strive to integrate engineering and geosciences perspectives into my classes. Engineering geology naturally concerns geologic processes, but I find myself spending more and more time talking about Plate Tectonics, as I would do in a geology class, as it provides a paradigm for all other earth processes. As mentioned previously, concepts of atmospheric processes can be used to predict the qualities of resulting storm hydrographs that can be applied seasonally and geographically beyond or as a compliment to standard intensity-duration-frequency curves. I have also brought a few lab activities over from my introductory geology or science education classes to engineering geology or hydrology. Although time consuming, the simple hands-on activity (e.g. molding geologic structures out of play dough) gives the student something to manipulate and they therefore absorb more of the content—and are probably happier about the entire experience.

Likewise I find engineering examples helpful in geology class, especially at the introductory level. I have heard from these students that taking geology 101 feels like learning a language: memorizing a bunch of foreign words that are not related. Engineering examples, especially analyses of natural hazards, are received as a welcome relief for students grateful for some concrete content. I plan to incorporate more engineering into my geosciences classes and am actively looking for places to do so. I look to this workshop in particular and the SERC online materials in general as a resource for making this happen.