

Teaching at the Intersection of Geoscience and Engineering

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I have the pleasure of teaching geology to first year civil and environmental engineering students through an introductory course entitled “Geology for Engineers”. I view my main teaching challenge to be helping new engineering students understand the relevance of geology to engineering. If they can develop an appreciation for why they need to know basic geology, they will be more likely to: (a) be eager learners in this required course outside their discipline; (b) be alert to geologic considerations as a practicing engineer; (c) know how to access, understand and integrate geologic data; (d) know when to consult a professional geologist and how to effectively communicate with a professional geologist on their team; and (e) be more likely to continue learning more about earth processes either formally or informally in the future. It’s a shame that about 80% of these students have no prior exposure to geology. For this reason, they tend not to understand why geology is being forced upon them while they take concurrent courses in other topics that they view to be much more obviously related to their chosen profession such as calculus, mechanics, and computer-aided drafting. I embrace this teaching challenge through a variety of approaches, each of which requires the students to articulate for themselves how geoscience relates to engineering.

On the first day of class, I ask them why they think this course is required for their major and we start to build connections immediately. We talk about the topics we will cover over the course of the semester and students begin to see how geoscience informs and relates to engineering decisions. On that same first day, I urge them to interrupt any activity at any time in the course when they cannot see a direct connection between the topic being addressed (whether its silicate minerals, fracture patterns in rocks, or bedrock mapping) and their goal of becoming an engineer. On occasion, I have had students do just this. These have been some of my favorite teaching moments. I put aside the lesson plan for the moment and we step back and look at the big picture. I redirect the questions to the class group: why is this topic important, what does it have to do with engineering and how does it relate to potential hazards, engineering materials, or natural resources managed by engineers, for example? In other words, “Who cares?” The students often help each other find the answers to these questions and it usually involves a lively discussion that inevitably results in numerous newfound connections between the geology du jour and their engineering pursuits.

I have developed a library research project that invites students to explore a specific topic of interest to them and present their findings to the class in the form of a poster presentation. The students are required to select a topic that lies at the intersection of geology and civil engineering. Geosciences and civil engineering are equally broad and the crossover area between them permits a seemingly endless range of choices for a research project. I offer the students a list of forty or so topics (e.g., hydrofracking) or case studies (e.g., the Vajont Reservoir disaster) they could

research, but students are also encouraged to come up with their own ideas. Most of the poster consists of two separate panels, one for geology considerations and another for engineering considerations. The abstract, context/background information and summary sections are areas where students elucidate the connections between the two components.

Extra credit is a remarkably effective motivational tool for encouraging and recognizing the effort involved in going to co-curricular events that in some way link geology to engineering. Throughout the semester I announce 15 or so extra credit opportunities from a diverse menu of guest speakers, field trips, and workshops that regularly occur on campus. Students are permitted to get credit for participating in up to three of these events (amounting to a maximum 3% increase in their test average at the end of the semester). To earn credit, students are required to submit a one page write up within one week of the event, half of which is a summary of the content and the other half is their response to the event. I really enjoy reading these responses because the students often report making discoveries about their own interests and misconceptions, and further develop points of view on complex societal questions that both geologists and engineers must tackle.

Given the degree to which geologists and engineers work together in the field and the degree to which these two disciplines overlap, it is critical to increase understanding and traffic between them. Sustainability is one of several key issues of this generation that straddle the boundary between the geosciences and engineering. There is no better time to work hard in the classroom to make the relationship between the two disciplines transparent.