

InTeGrate Essay on Teaching Sustainability in an Interdisciplinary Context

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My main motivation for teaching sustainability is to promote solutions-oriented thinking about environmental challenges. Rather than focusing solely on the problems, we can empower students to evaluate solutions and become innovators. I've always been an optimist, and it is hard for me to focus on any issue – much less the future human existence! – without hope that it can be solved. My own path into environmental research came through applied math, into weather and climate, and then into global and regional air quality analysis. Along the way, I have seen that there are solutions – lots of them. I'd like to help students see opportunities to build a more sustainable world, and to have the analytic tools and frameworks to make informed decisions.

One problem about decision-making on sustainability is the complexity of the human and natural systems involved. Why does CO₂ warm the climate, but SO₂ impacts health? Why does fertilizer use in the Midwest impact water quality and biodiversity in the Gulf of Mexico? Unfortunately, most students don't get exposed to these cross-cutting issues until they are advanced in a particular major. Electrical engineers learn about energy systems; geologists learn about fossil fuel reserves; atmospheric scientists learn about climate change. Even then, students typically approach each issue from a deep disciplinary perspective.

Rather than the capstone on disciplinary expertise, I would like to see sustainability – even the quantitative, complex aspects of science and engineering – taught in an interdisciplinary manner at the undergraduate level. In my experience, students don't have to solve lots of equations to understand electricity systems or climate change. In fact, there are some basic tools – accessible with a few calculus concepts, or less, link together many major sustainability issues. In my framing of sustainability science (a work in progress) these include: back-of-the-envelope problem solving, systems dynamics, quantifying risk, life-cycle analysis, working across spatial and temporal scales, working with unfamiliar metrics (e.g. ppm, kWh, footprint, LEED), and utility of model-based data vs. measurement data.

At UW-Madison, I am developing a new course: "Introduction to Sustainability Science," geared toward 1st and 2nd year undergraduates. The course fulfills our physical science requirement (both in the College of Letters & Sciences, and in the recently launched Environmental Studies major), and aims to teach the quantitative skills noted above. I offered it once before – in Spring 2011 – and I will offer a new-and-improved version in Spring 2013. I am looking forward to the discussions at InTeGrate to help shape this new course.

Although I have serious goals in designing the course, I have given a lot of thought as to how to make classes fun and engaging for the students. Toward the fun aim, I include about 3 field trips – around campus or town – into the course. I ask guest speakers to talk both about issues in the class, and how these play out in their careers and life. I write homework problems that are (somewhat?) engaging: interactive role-playing software, NASA data sets, and campus-scale back-of-the-envelope problems. Where lecture is needed, I am trying out the recommended approach of Edward Tufte (<http://tinyurl.com/yo9hw7>). And, I grade on a cumulative point scale – hopefully reflective of students' cumulative knowledge. I offer lots of extra credit options, almost exclusively tied into campus engagement – attending public lectures, participating in an innovation competition, touring campus research labs and posting a video summary. This approach allows me to grade homework and tests rigorously, while providing students the feeling that anyone can get an "A" with enough focus and work. As a last point, I'd really recommend the book is "Switch" by Chip and Dan Heath – it suggests creative approaches to leadership, many of which fit teaching well.