



“InTeGrate”ing Engineering, Sustainability, and the Geosciences

Undergraduates in EOAS courses already benefit by learning from our highly integrated group of faculty with their wide ranging scientific and applications orientations. So what can we learn from a workshop on “integrating” engineering and geoscience? This page summarizes results with relevance for all EOAS instructors.

Purpose and participants

InTeGrate (<http://serc.carleton.edu/integrate/about/index.html>) is a 5-year, NSF-funded STEP Center grant. Two major goals of this so-called “STEM Talent Expansion Program” are:

1. To develop curricula that will dramatically increase geoscience literacy of all undergraduate students.
2. Increase the number of majors in the geosciences and associated fields who are able to work with other scientists, social scientists, business people, and policy makers to develop viable solutions to current and future environmental and resource challenges.

InTeGrate workshops are run as a combination of plenary talks, panelist presentations, discussions and time for collaborative development of ideas and materials. Workshop results, which are presented and summarized in real time, include an overview, list of participants, essays, courses & activities that they delivered, and summary pages. These can all be seen in detail here:

<http://serc.carleton.edu/integrate/workshops/engineering2013/index.html>.

Some take-home messages of interest in EOAS

After an intense, rewarding 3 days, participants gained a new appreciation for the perspectives of both geoscientists and engineers. There was also significant excitement about opportunities for motivating and teaching students by incorporating engineering aspects into geoscience courses, and vice-versa. We also learned of some challenges that arise with such integration in educational settings, as well as some ways of mitigating these potential pitfalls.

From the workshop summary, some lessons we can all apply in many of the courses we teach are as follows. Can you think of specific settings in which you teach that are relevant for any of these points?

1. Integrating engineering, geoscience and social science is powerful because it
 - a. provides a context for learning,
 - b. allows students to address complicated problems,
 - c. facilitates practice at working in collaborative teams, and
 - d. highlights the distinctively different roles, approaches and perspectives of engineers and geoscientists.
2. Valuing the perspectives and skills that others bring to a problem is important. Integration helps students fully appreciate how success depends upon collaboration among people with different skills, backgrounds, life experiences, sensitivities and motivations.
3. Some **opportunities** enabled by such integration:
 - a. Introduce strategies that bring strengths of different groups together.
 - b. Sustainability is relevant to both disciplines.

- c. Link process and design work at all levels of curriculum to enhance continuity, depth of learning, transfer of learning into new settings, and to add “relearning” or “revisiting” opportunities.
 - d. Real world experiences can help motivate and focus collaborative problem solving.
 - e. Current events can be effective for highlighting multidisciplinary issues.
 - f. Integration also has the potential to increase diversity.
4. Some **challenges** of integrating geoscience and engineering:
 - a. Students in different programs bring different expectations, interests and goals to their learning.
 - b. There is always pressure on instructional time and the need to lower degree completion time.
 - c. Commonly, an emphasis on content at the expense of skill development and critical thinking.
 - d. Sustainability may be relevant but it can mean different things to people from different disciplines, cultures, and geographic regions.
 5. Integration at introductory levels is important for developing a collaborative culture and fostering interests and changing expectations among future geoscientists and engineers, as well as among our service students.
 6. Geoscience students tend to be better at grasping the origin and limits of numbers and their relationship to observation, while engineering students may be stronger with numerical problem solving. These differences can be a barrier to collaboration, but awareness and creativity of teachers can turn this into an opportunity.
 7. There is value in advising students to take courses in the complementary discipline.

Activities, courses and essays that may be of interest to EOAS teaching faculty

These were delivered by participants or developed during the workshop. They, like the “other related resources” below, are available publically, and should provide **inspiration** and/or **concrete materials**, for many teaching situations in EOAS, ENVR and ATSC courses in our Department.

- **Ten activities targeting 1st or 2nd year levels:** details at <http://serc.carleton.edu/69852>
- **Six activities targeting 3rd or 4th year levels:** details at <http://serc.carleton.edu/69852>
- **15 relevant courses** are described at <http://serc.carleton.edu/69854>
- **30 essays** written by participants prior to the workshop on the topic of integrating engineering, sustainability and geoscience in undergraduate education; see <http://serc.carleton.edu/69857>
- **Several ongoing proposals** to author, test, revise and publish model courses and modular teaching materials, with support from **InTeGrate** Project funding (see <http://serc.carleton.edu/68057>).

Other related workshops and resources

- Other past and future **InTeGrate** workshops <http://serc.carleton.edu/integrate/workshops/index.html> (EOS-SEI also participated at the workshop “*Programs that Bring Together Geoscience and Sustainability*” in May 2012.)
- The SERC Science Education Resource Center at <http://serc.carleton.edu/600>, especially “*On The Cutting Edge*” resources for geoscience faculty, including 1) Managing your Career, 2) Enhancing your Career, and 3) Teaching about [28 specific] Geoscience Topics and Themes.

CWSEI: <http://www.cwsei.ubc.ca/resources/index.html> EOS-SEI: <http://www.eos.ubc.ca/research/cwsei/>

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