InTeGrate
Interdisciplinary Teaching of Geoscience for a Sustainable Future

Bringing engineers and geoscientists together to improve undergraduate teaching about sustainability

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GSA, 2013

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Interdisciplinary Teaching of Geoscience for a Sustainable Future

- Geoscience must come together with other disciplines to address significant environmental and resource challenges.
- Integrating engineering and geoscience instruction
  - Provides a context for learning
  - Allows students to address complicated problems
  - Gives practice working in teams as they will encounter in the workforce

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InTeGrate - A five-year community effort to improve geoscience literacy and build a workforce prepared to tackle environmental and resource issues

InTeGrate supports the teaching of geoscience in the context of societal issues both within geoscience courses and across the undergraduate curriculum

GSA, 2013

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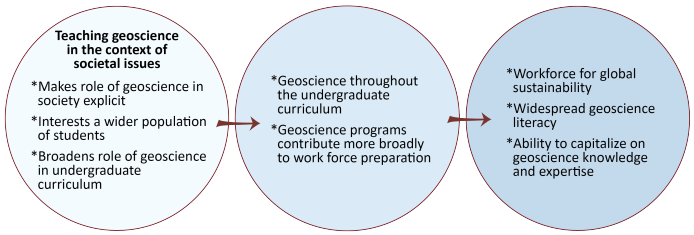

Implicit in this model is that InTeGrate supports transformation of teaching in higher education to support engaged learning.

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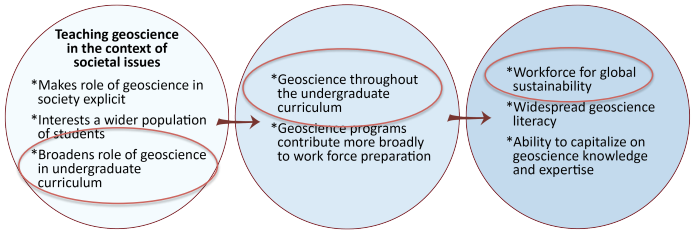

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Engineering, Sustainability and the Geosciences workshop

- Brought together engineers and geoscientists from 30 institutions
- Pre-workshop contributions from participants
  - Example activities, activity ideas, and course materials
  - Essays describing how they integrate geoscience and engineering to address sustainability in the classroom
- Contributions plus workshop discussions informed a set of InTeGrate web pages on strategies for interdisciplinary teaching about sustainability
- Addressing the differences in the 2 cultures was a key topic

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Contrasting Interests

Geoscientist	vs.	Engineer
Why?		So what?
Understanding		Significance
Bedrock		Surficial deposits
Where are outcrops?		How deep is bedrock?
What process created it?		Is it still active?

Past-oriented model: present is key to the past

Future-oriented model: recent past is key to near future

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5 words to describe…

Engineering to geologists:

- Practical (multiple constraints)
- Quantitative (need values to work with)
- Resourceful (how can we do this?)
- Linear
- Solution-driven (have to pull the trigger sometime)

Geology to engineers:

- Vast (ancient, large)
- Ambiguous
- Cyclical (dynamic processes)
- Observational (forensic)
- Hypothesis-driven (hold competing thoughts in balance)

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Two approaches to problem solving

- Engineers
  - Work to efficiently find an appropriate solution
  - Quantitative perspective
- Geoscientists
  - Focus on understanding the problem
  - Critical thinking about different possibilities or outcomes

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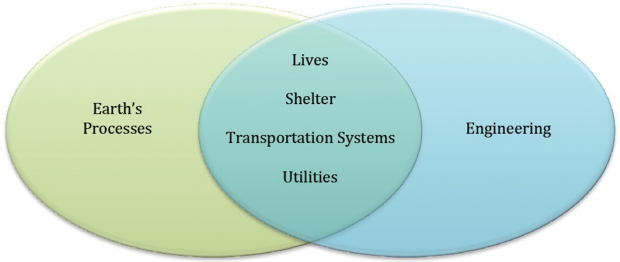
Points of intersection



LeAnne Teruya

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The continuum

Geologist
Environment of deposition, stratigraphic packages

Engineering Geologist / Geomorphologist
Water-bearing units, extent and trend and variability

Hydrologist
Aquifer flow parameters, contaminant transport

Environmental Engineer
Clean-up technology, pumps and piping, chemistry

Significant overlap

Hazardous Waste Site Cleanup

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The continuum

Geologist
Mineral suite, origin, extent

Geological Engineer
Pit slope design, water control

Mining Engineer
Extraction plan, mine layout

Metallurgical Engineer
Processing system

Minimal overlap

Mine Design

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Challenges communicating between cultures

- Areas of overlap reduce appreciation of need for other fields
- Value different parts of the problem-solving process (hypothesis – front end vs. solution – back end)
- Embracing ambiguity vs. focus on practicality
- Students want different things out of classes

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What students want out of courses

Geoscience:

- Tools to describe the landscape
- Consideration of complex problems
- Look at processes on a planetary scale
- Appreciation
- "I understand this"

Engineering:

- Problem-solving tools
- Quantitative skill
- Elegant, clever solutions
- Know-how
- "I can do this"

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Building a culture of collaboration

- Explicitly address the strengths of different disciplines
- Help students to recognize that different disciplines have different values, beliefs, and ways of solving problems
- Invite guest speakers from other disciplines
- Provide problems that require expertise from different disciplines for their solution
- Show the value of different parts of the problem-solving process, from the hypothesis through to the solution
- Acknowledge that students want different things out of classes
  - Provide a breadth of learning opportunities

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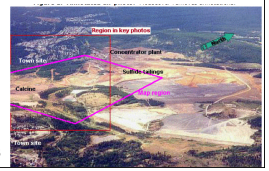
Sample activities in collection

- Assessing Water Resource Demand in New York
- Physical model of the failure of an unreinforced structure during an earthquake
- Runoff Generation from Varying Land Surfaces
- Learning to integrate geophysics into engineering projects using a set of interactive, online, scenario-based resources



Francis Jones

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New module in development - Water Sustainability in Cities

- Topics include
  - Urban water systems, hydrology, and atmospheric interactions
  - Sustainable and resilient infrastructure
  - Planning and decision making
- Will be tested in both geoscience and engineering departments

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Summary

- Interdisciplinary teams are needed to provide sustainable solutions to critical environmental and resource issues
- Engineers and geoscientists have distinctively different roles, approaches and perspectives, and successful implementation relies upon mutual appreciation of these differences
- Community involvement in InTeGrate is leading to a new set of interdisciplinary resources for teaching about sustainability