Engaging Undergraduates in Soil Sustainability Decision-making

Hannah Scherer, Sarah Fortner, & Martha Murphy
What is InTeGrate?

NSF’s STEP Center in the Geosciences

A 5-year community effort to improve Earth literacy and build a workforce prepared to tackle environmental and resource issues

*InTeGrate supports integrated interdisciplinary learning about resource and environmental issues across the undergraduate curriculum to create a sustainable and just civilization.*
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Sustainable agriculture as an interdisciplinary grand challenge

Foley et al., 2005
• ~ 2 weeks in a typical undergrad lecture course
• Ready-to-use activities
• Formative and summative assessments
• Student materials
• Editable masters
Module goals

• Students will use geologic data to develop a plan for sustainable soil management in one or more agricultural settings
• Students will predict, using systems thinking, agricultural challenges that might result from climate change
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6 units (~50 min each)

1. Impacts of land use
2. Soil characteristics and their relationship to land use practices
3. Natural and agricultural erosion rates
4. Using SoilWeb to investigate the soil beneath you
5. Predicting the effects of climate change on soil loss
6. Creating an agricultural “Fact Sheet”
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Development context: three settings

1) Interdisciplinary Ecological Agriculture Course at a Land Grant Institution

1) Geology of the Critical Zone Course at a 4-year Private College

1) Introduction to Environmental Science at a 2-year Community College

Adaptations & field extensions are discussed in instructor stories.
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Module development process (~2 years)

<table>
<thead>
<tr>
<th>Writing</th>
<th>Review &amp; revisions</th>
<th>Piloting and data collection</th>
<th>Data analysis</th>
<th>Revisions</th>
<th>Final review &amp; revisions</th>
<th>Publication</th>
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InTeGrate Materials Design Rubric

http://serc.carleton.edu/integrate/info_team_members/currdev/rubric.html#scoring

Data sources:
- Student work
- Focus groups
- Classroom observations
- Author reflections
- Postcourse essay

Input:
- Scientific review (peer)
- Technical review (web)
- Copyediting
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SOIL!EROSION!  CLIMATE(CHANGE

Why Should YOU Take Action?
To keep your waterways clean!
Recharge groundwater for instead of contributing to run-off!
Conserve soil to be used in agriculture and food production!
Take care of our planet!
For more information please check out
http://www.ext.vt.edu/!!111111!!or!!1111111www.usgs.gov/111111

Recommendations: the 4 A’s of reducing Erosion

#1 Avoid bare soil - plant cover crops or mulch around trees and shrubs

#2 Across slope tilling instead of down the slope

#3 Add landscaping to slow down water - it’s pretty too!

#4 Augment soil with organic matter such as compost to improve quality

ECOLOGICAL AGRICULTURE
905530712!
905608652!
905502789!
905547951!

9055530712!
905608652!
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905547951!

Summative Assessment:
Fact sheet

Scores: 60% - 98%
(n = 31)
### Summative assessment review

**Degree to which assessment reflects ...**

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<td>... the nature and methods of geoscience and developing geoscientific habits of mind.</td>
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<td>... use of authentic and credible geoscience data to learn central concepts in the context of geoscience methods of inquiry.</td>
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## A Growing Concern
### Student focus groups and classroom observations

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<th>Weaknesses</th>
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<td>• Interactivity/hands on</td>
<td>• Ambiguity of learning objectives</td>
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<tr>
<td>• Learned content</td>
<td>• Unclear about structure</td>
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<tr>
<td>• Open-ended inquiry</td>
<td>• Unprepared for math</td>
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<tr>
<td>• Quantifying a complex process</td>
<td>• Lack of personal relevance</td>
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<tr>
<td>• Student-centered teaching</td>
<td>• Fast pace/overwhelmed</td>
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<td>• Fostered student discussion</td>
<td>• Prescriptive worksheets</td>
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<td>• Complexity of climate change</td>
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<td>• Lack of concrete solutions</td>
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Postcourse interdisciplinary essay question

- A Growing Concern (n=22)
- All InTeGrate Modules (n=180)
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Revisions to module

Authentic data
Local context
Systems diagrams

(SoilWeb: http://casoilresource.lawr.ucdavis.edu/)

(Wilkinson and McElroy, 2007)

(Pruski, and Nearing, 2002)
Replace your lecture-based soils content today!

- Intro soil science
- Intro environmental science
- Intro geology
- Sustainability courses
- Interdisciplinary courses

Instructor Stories:
https://serc.carleton.edu/integrate/teaching_materials/sustain_agriculture/instructor_stories.html
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Check out other InTeGrate Modules!

**Critical Zone Science**
Martha Conklin (University of California, Merced); Ashlee Dere (University of Nebraska - Omaha); Susan Gill (Stroud Water Research Center); Adam Hoffman (University of Dubuque); Erin Stacy (University of California, Merced); James Washburne (Pima Community College and University of Arizona); Timothy White (Pennsylvania State University); Adam Wymore (University of New Mexico)

**Water, Agriculture, and Sustainability**
Nicole Davi (Lamont-Doherty Earth Observatory & William Paterson University of NJ), Terri Plake (Northwest Indian College), Chris Sinton (Ithaca College), Robert Turner (University of Washington Bothell); Editor: David Gosselin (University of Nebraska at Lincoln)

**Carbon, Climate, and Energy Resources**
Callan Bentley (Northern Virginia Community College), Pete Berquist (Thomas Nelson Community College), Pamela J.W. Gore (Perimeter College, Georgia State University); Editor: David McConnell (North Carolina State University)

**The Wicked Problem of Global Food Security**
Rebecca Boger (CUNY Brooklyn College), Russanne Low (University of Nebraska, Lincoln), Amy Potter (Armstrong State University); Editor: John Taber (IRIS Consortium)

**Systems Thinking**
Lisa Gilbert (Williams College), Deborah Gross (Carleton College), Karl Kreutz (University of Maine); Editor: David McConnell (North Carolina State University)

[http://serc.carleton.edu/integrate/index.html](http://serc.carleton.edu/integrate/index.html)
A Growing Concern
Sustaining Soil Resources through Local Decision Making

Thanks!

Email: hscherer@vt.edu


https://serc.carleton.edu/integrate/teaching_materials/sustain_agriculture/index.html