

# InTeGrate

*Interdisciplinary Teaching about Earth  
for a Sustainable Future*



## Engaging Undergraduates in Soil Sustainability Decision-making

*Hannah Scherer, Sarah Fortner, & Martha Murphy*



This work is supported by a National Science Foundation (NSF) collaboration between the Directorates for Education and Human Resources (EHR) and Geosciences (GEO) under grant DUE - 1125331



# What is InTeGrate?

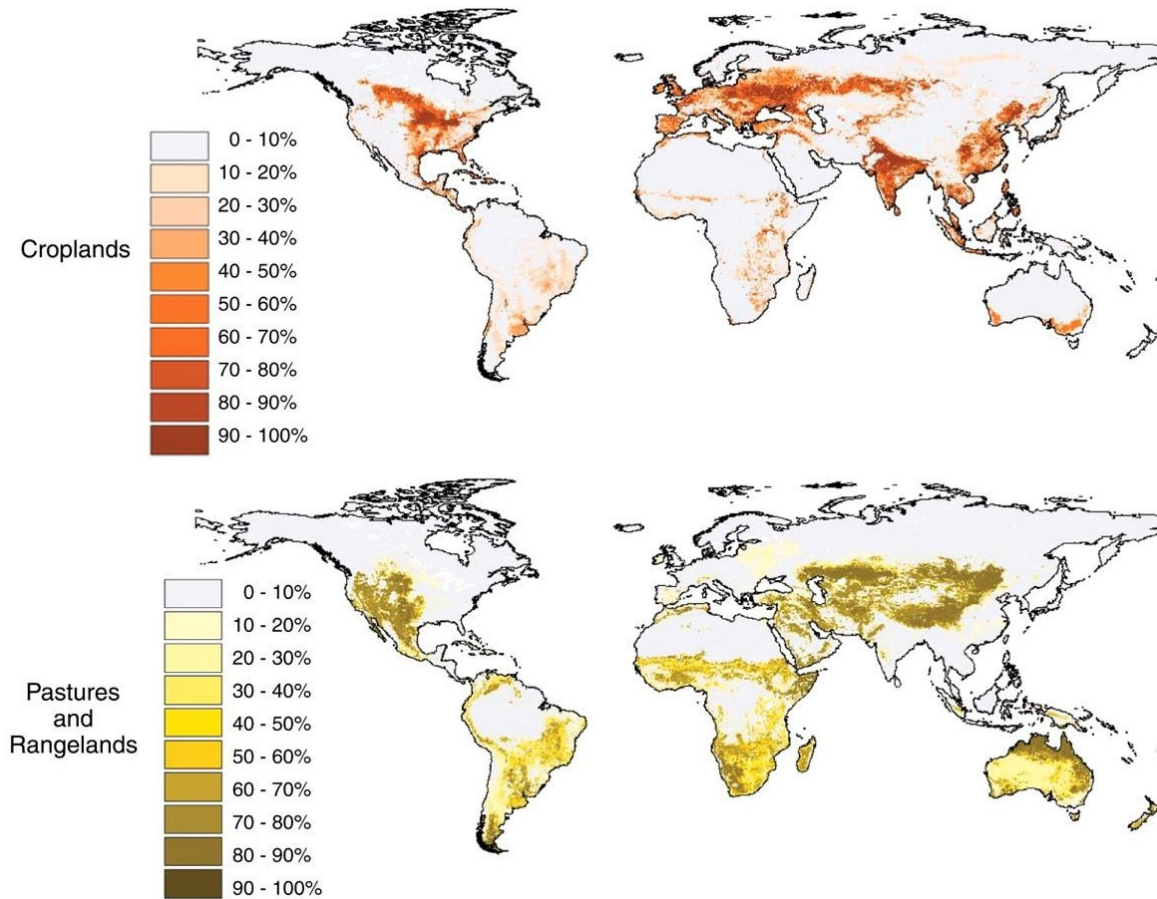
NSF's STEP Center in the Geosciences

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.*

# A Growing Concern

## Sustainable agriculture as an interdisciplinary grand challenge



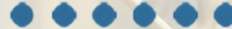


## A Growing Concern: Sustaining Soil Resources through Local Decision Making

100 200 300 400

Intro Level

2-3 Weeks



6 Units

[Sarah Fortner \(Wittenberg University\)](#)

[Martha Murphy \(Santa Rosa Junior College\)](#)

[Hannah Scherer \(Virginia Tech\)](#)

- ~ 2 weeks in a typical undergrad lecture course
- Ready-to-use activities
- Formative and summative assessments
- Student materials
- Editable masters



# A Growing Concern

## 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



# A Growing Concern

## 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”

# A Growing Concern

## 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.*

# A Growing Concern

## Module development process (~2 years)



InTeGrate Materials  
Design Rubric

[http://serc.carleton.edu/integrate/info\\_team\\_members/currdev/rubric.html#scoring](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



# A Growing Concern



## SOIL!EROSION! CLIMATE(CHANGE

### Why Should YOU Take Action?

To keep your waterways clean!

Recharge groundwater for instead of contributing to runoff!

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>!!!!!![www.usgs.gov](http://www.usgs.gov)!!!!!!

! **Virginia  
Cooperative  
Extension**



Recommendations: the 4  
A's of reducing Erosion

! ———  
#1 **A**void bare soil- plant  
cover crops or mulch  
around trees and shrubs

! ———  
#2 **A**cross slope tilling  
instead of down the  
slope

! ———  
#3 **A**dd landscaping to  
slow down water- it's  
pretty too!

! ———  
#4 **A**ugment soil with  
organic matter such as  
compost to improve  
quality

**ECOLOGICAL  
AGRICULTURE**

905530712!

905608652!

905502789!

! ———  
905547951!

# Summative Assessment: Fact sheet

Scores: 60% - 98%  
( $n = 31$ )

# A Growing Concern

## Summative assessment review

Degree to which assessment reflects ...

Module Learning Goals	Fact Sheet Assignment
...ability to use geological data to develop a plan for sustainable soil management in one or more agricultural settings.	2.5
...ability to predict agricultural challenges that might result from climate change using systems thinking.	2.5

### InTeGrate Guiding Principles

... competence explaining one or more <b>geoscience-related grand challenges</b> facing society .	3
... ability to <b>address interdisciplinary problems</b> .	2.5
... the nature and methods of geoscience and <b>developing geoscientific habits of mind</b> .	2.5
... use of authentic and credible <b>geoscience data</b> to learn central concepts in the context of geoscience methods of inquiry.	3
... ability to incorporate <b>systems thinking</b> .	2.5

# A Growing Concern

## Summative assessment review

Degree to which assessment reflects ...

Module Learning Goals	Fact Sheet Assignment	Student Work
...ability to use geological data to develop a plan for sustainable soil management in one or more agricultural settings.	2.5	2
...ability to predict agricultural challenges that might result from climate change using systems thinking.	2.5	2

### InTeGrate Guiding Principles

... competence explaining one or more <b>geoscience-related grand challenges</b> facing society .	3	3
... ability to <b>address interdisciplinary</b> problems.	2.5	2.5
... the nature and methods of geoscience and <b>developing geoscientific habits of mind</b> .	2.5	2
... use of authentic and credible <b>geoscience data</b> to learn central concepts in the context of geoscience methods of inquiry.	3	2
... ability to incorporate <b>systems thinking</b> .	2.5	1.5

# A Growing Concern

## Student focus groups and classroom observations

### Strengths

- Interactivity/ hands on
- Learned content
- Open-ended inquiry
- Quantifying a complex process
- Student-centered teaching
- Fostered student discussion

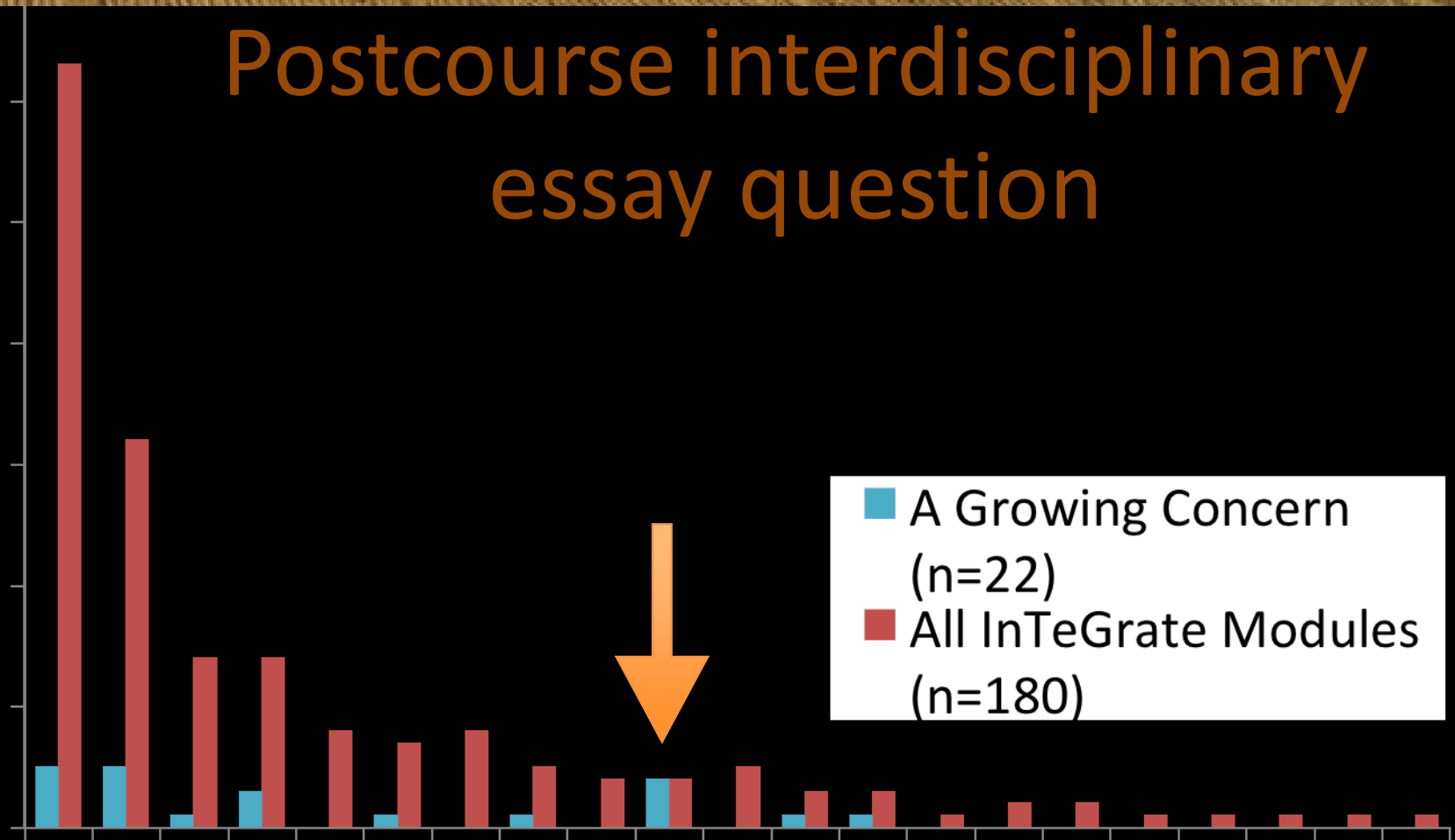
### Weaknesses

- Ambiguity of learning objectives
- Unclear about structure
- Unprepared for math
- Lack of personal relevance
- Fast pace/ overwhelmed
- Prescriptive worksheets
- Complexity of climate change
- Lack of concrete solutions



# A Growing Concern

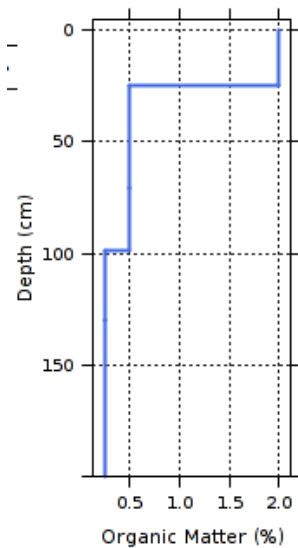
## Postcourse interdisciplinary essay question



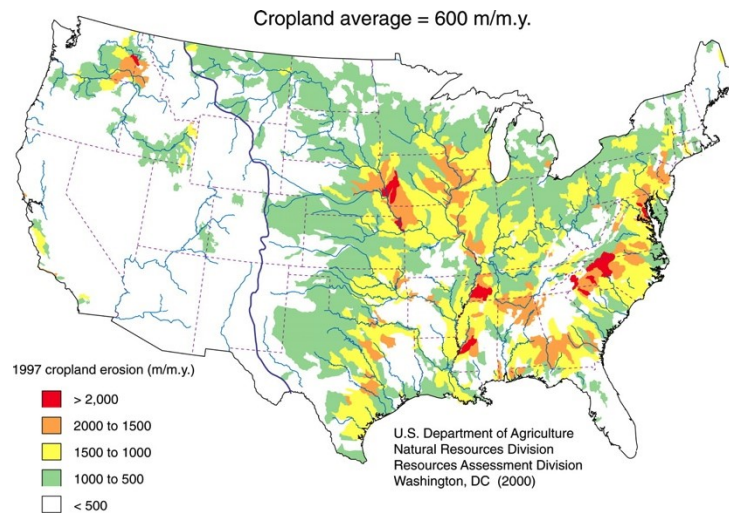
# A Growing Concern

## Revisions to module

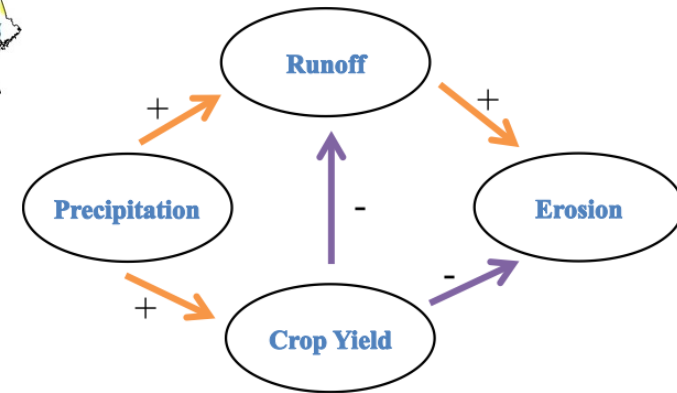
Authentic data



Local context



Systems diagrams



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

(Wilkinson and McElroy, 2007)

(Pruski, and Nearing, 2002)

# A Growing Concern

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](https://serc.carleton.edu/integrate/teaching_materials/sustain_agriculture/instructor_stories.html)

# A Growing Concern

## 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



### **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)

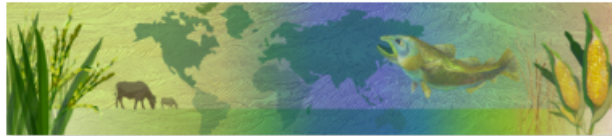
► [Show module description](#)



### **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)

► [Show module description](#)



### **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)

► [Show module description](#)



### **Systems Thinking**

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

► [Show module description](#)



# A Growing Concern

*Sustaining Soil Resources through Local Decision Making*

## Thanks!

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Fortner, S., Scherer, H. H., & Murphy, M. (2016). Engaging undergraduates in soil sustainability decision-making through an InTeGrate module. *Journal of Geoscience Education*, 64(4), 259-269.

[https://serc.carleton.edu/integrate/teaching\\_materials/sustain\\_agriculture/index.html](https://serc.carleton.edu/integrate/teaching_materials/sustain_agriculture/index.html)