

Climate Science Across the Liberal Arts Curriculum at Gustavus Adolphus College

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Nearly a decade ago, UN Secretary General Ban Ki Moon called climate change "the defining challenge of our age" and challenged the world's nations to address this issue. Recent events and scientific findings have clearly affirmed the urgency of his call to action, and institutions of higher education are seeking ways to respond.



Program Motivation

Climate change and its causes are important topics in many science courses, and at Gustavus, we found that a significant proportion of faculty members in other disciplines are also very interested in climate change. However, few of those faculty members were actually teaching about climate-related topics in their courses, despite seemingly ample opportunities. For example, Economics courses might address economic threats related to agricultural productivity changes; Communications Studies courses might use climate science to catalyze discussions about pseudoscientific arguments; Chemistry courses might experimentally simulate ocean chemistry change.

We set out to discover why so few faculty members were teaching this topic, about which they so clearly care, and to help break down barriers to climate teaching.

Program Goals:

Teachers in many disciplines want to teach about some aspect of climate change in their courses, but they may fail to do so for a variety of reasons. We used teaching circles composed of diverse faculty members to:

- [Identify and remove barriers for faculty incorporation of climate-related content in courses outside the sciences.](#)
- [Develop climate science primers and modules for use by non-specialist faculty in existing non-science courses in the humanities, social sciences, arts and natural sciences.](#)
- [Implement modules in existing Gustavus courses and assess the impact on student climate literacy.](#)



Climate literacy – a collaborative effort

This project represents the collaborative intersection of two groups of faculty members at Gustavus:

Group 1: Faculty outside climate science (Host faculty)

Courses all over campus address the human and social dimensions of climate change

Faculty outside the sciences see climate change as a pressing challenge that today's students must be prepared to address

These faculty aren't experts in the science of climate change.

Group 2: Faculty who teach climate science (InTeGrators)

Climate science faculty routinely teach about the mechanisms, causes, and consequences of climate change.

Their student audience is limited to those who enroll in suitable science courses.

This project brings these two groups together to reach a larger cross-section of the student body, improving climate literacy across campus and developing a set of teaching materials that can be used by faculty members in many kinds of courses.

Challenges & Barriers

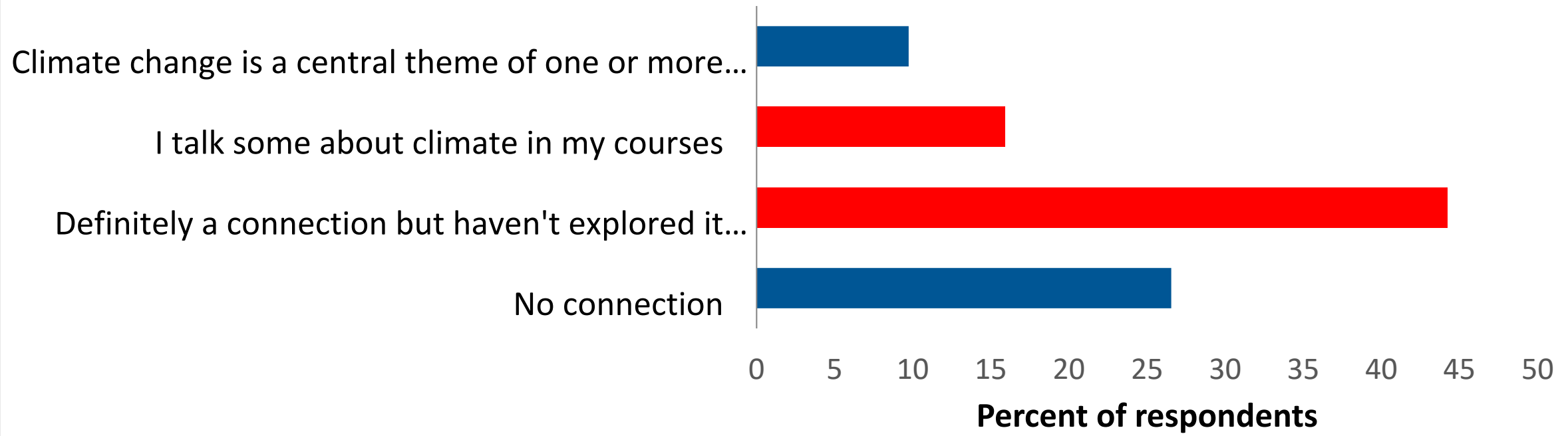
Potential host faculty (most faculty at the institution)

See connections between their disciplines and climate change, but these connections may not be fully developed in courses

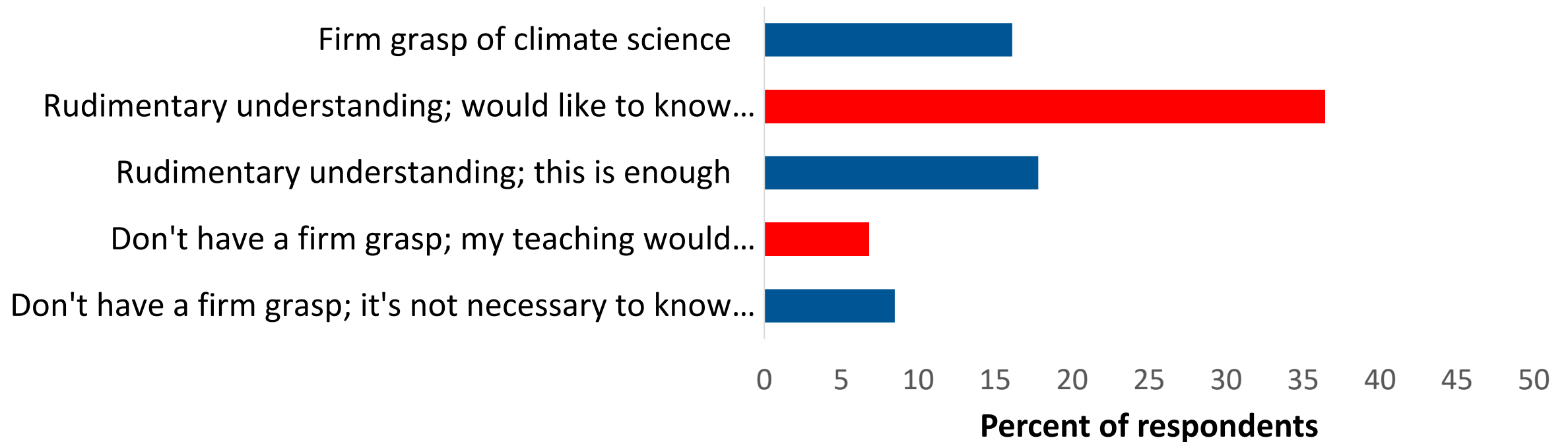
Feel that they do not have enough information to effectively teach the science behind our understanding of climate change

The following graphs summarize the results of two questions from an all-faculty survey administered prior to the start of the project. 121 respondents (~55% of the faculty) completed the survey.

Do your courses intersect themes related to climate change?



Faculty: Understanding of Climate Science



Responses highlighted in red indicate the target population of potential host faculty members: these instructors see a connection between climate science and their course content but may feel that science knowledge is a barrier to maximizing their inclusion of climate science data in their courses.

Project objectives

- Identify host faculty members who seek to include more content related to climate change in their courses
- Develop climate science content modules that support inclusion of climate change as a topic in non-science courses
- Use InTeGrator faculty to introduce modules in non-science courses
- Develop independence in host faculty for future implementation of climate science modules
- *Target:* Develop modules for ~12 courses over the three-year project term

Implementation

We have now completed the full collaborative development cycle four times, beginning in Spring of 2014. This cycle is described below:

Development step	Outcome
Call for host faculty applications (Spring 2014)	9 faculty members from 9 departments applied to attend a content development workshop
Content development workshop (Summer 2014)	6 host faculty members attended (6 departments represented)
Collaborative development of modules (Fall 2014)	5 host faculty members + 4 InTeGrators developed five climate science modules
Modules were reviewed (Fall 2014)	Host + InTeGrator presented module to an audience of 2-3 InTeGrators and 0-2 student reviewers; modifications to modules made based on feedback
Initial implementation in host classrooms (Fall 2014)	4 modules were piloted in 6 sections of four courses (162 students); observation of delivery
Implementation by host faculty (Spring 2015 or Fall 2015)	Host faculty adopts module, making it a permanent part of the course

Assessment

Students will

recognize that climate change is occurring and affects many dimensions of human endeavor
describe the scientific understanding of the causes of warming and the changes that occur as a result of warming

Host Faculty will

Be comfortable discussing basic climate science in the context of their courses
Expand the treatment of climate change in their courses

InTeGrators will

Expand their repertoire of basic climate science teaching content
Increase their understanding of the ways climate science impacts human and social endeavors in fields outside the geoscience

Example Modules

Scientific Debate and the Nature of Certainty

Developed by Laura Triplett, Geology

Host faculty member: Mary Gaebler, Religion

Course: Faith, Religion & Culture (2 sections,
25 students each)

Main ideas:

The nature of science & peer review

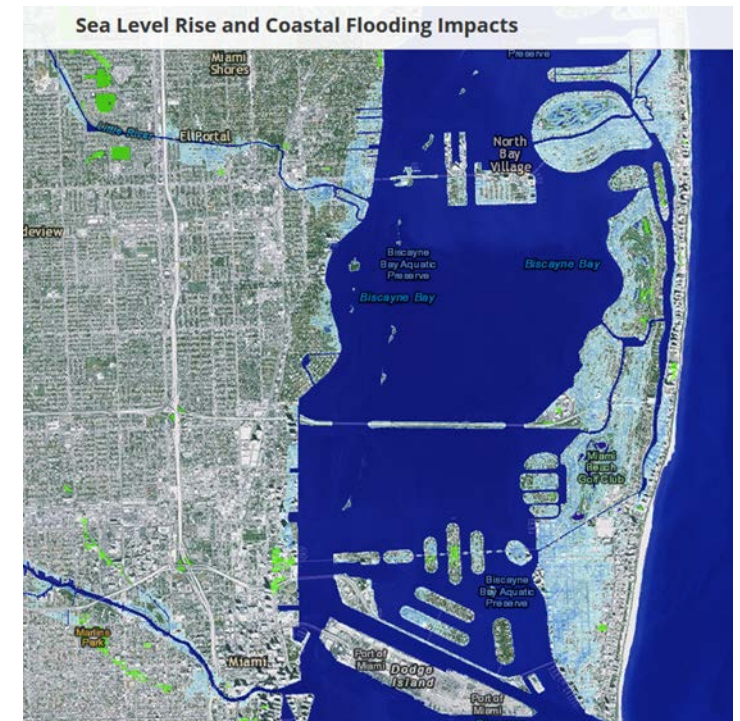
Where do models and projections come from?

What is the nature of the debate about climate change?

Student follow-on:

5-7 page paper: *Considering Climate Change: An Analysis of Agency*

Students summarize and critically analyze the facts of climate change and analyze their capacity for action



Example Modules

British Literature and Global Climate Change

Developed by Michele Koomen, Education

Host faculty member Deborah Downs-Miers, English

Course: British Literature I (1 section, 15 students)

Main ideas:

Mechanisms of climate change

Phenology

Impact of climate change on civilization

Student connections:

Students read *Orlando*, and connect climate events such as the Little Ice Age with historical fiction



Example Modules

The Tragedy of the Commons

Developed by Laura Triplett, Geology
Host faculty member: Rita Ray, Economics
Course: Macroeconomics (2 sections,
36 students each)

Main ideas:

The atmosphere is a “commons”

Climate change is an example of a Tragedy of the Commons

Potential solutions may be similar to those in other commons

Student connections:

Examination of the atmosphere as a commons with economic value



Cows on the Selsley Common, United Kingdom

Example Modules

Exercise in a Changing Climate

Developed by James Dontje, Environmental Studies
Host faculty members: Bonnie Reimann, Laurel Jordan,
Health Exercise Science
Course: Personal Fitness (1 section, 25 students)

Main ideas:

Nature and causes of climate warming

Physiology of exercise in warm conditions; limits for exercise

Student connections:

Consequences for personal wellness

This course is required for all Gustavus students; the climate science primer in this module will be adopted as an online resource for all sections of this course (~700 students per year)

Death, Havoc and Heat Mar Chicago Race



<http://www.nytimes.com/2007/10/08/us/08chicago.html>

Unexpected Outcomes

- Faculty within and outside climate science disciplines established robust lines of communication and collaboration regarding climate change issues in the classroom.
- Some mini-modules were more successful than others.
- It may be difficult to 'un-hook' a climate science mini-module from the developer and make it self-sustaining in the host course.

Long-term Impact and Next Steps

The process created by this project provides a path by which additional mini-modules can be developed when other faculty members become interested or arrive on campus. Next steps are to:

- Work with our institution to encourage and support this module development in future years
- Refine existing modules and help them evolve through time
- Survey exiting graduates to determine the magnitude of climate literacy improvement in the student population as a whole
- Work with our institution to expand this mode of cross-disciplinary teaching, perhaps offering it as a model to developing cross-disciplinary general education courses.

Conclusions/lessons learned

Faculty express a desire to include more climate content in their courses

Climate science knowledge can be a barrier for non-geoscience faculty to discuss climate change in their courses

Faculty who routinely discuss climate science in their courses (InTeGrators) can be effective resources for faculty outside the sciences

A shared understanding of instructional goals is crucial to success of the collaboration.

InTeGrators must adapt the module to the pedagogic framework of the host faculty member

A wide variety of courses are suitable for inclusion of climate content

More Information at:

serc.carleton.edu/integrate/programs/implementation/program2/index.html

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serc.carleton.edu/integrate/

