

# Triggering Epicenters in Geoscience: Fostering the Next Generation of Seismologists

**Stefany Sit<sup>1</sup> and Michael Hubenthal<sup>2</sup>**

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<sup>1</sup>Univ of Illinois at Chicago, <sup>2</sup>IRIS Education and Public Outreach



# Fostering the Next Generation of Seismologists

## WHICH QUESTION INTERESTS YOU MOST:

- 1) Are you worried about building students' abilities to **Problem Solve, Use Quantitative Reasoning, and Understand Models**
- 2) Are you interested in the **Access and Success of All Students and Especially Under-Represented Groups in the Geosciences**
- 3) Have you thought about new **Instructional Strategies to Improve Geoscience Learning in Different Settings and with Different Technologies**

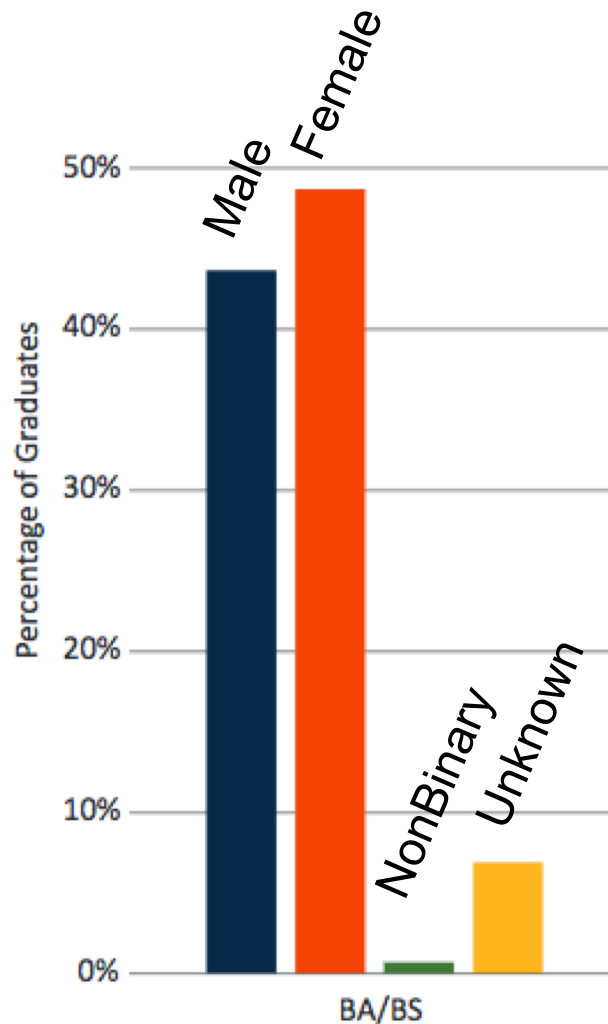
All are a part of the new **Geoscience Education Research Grand Challenges**

[https://nagt.org/nagt/geoedresearch/grand\\_challenges/feedback.html](https://nagt.org/nagt/geoedresearch/grand_challenges/feedback.html)

→ IRIS Internship Program has been working to address Access and Success

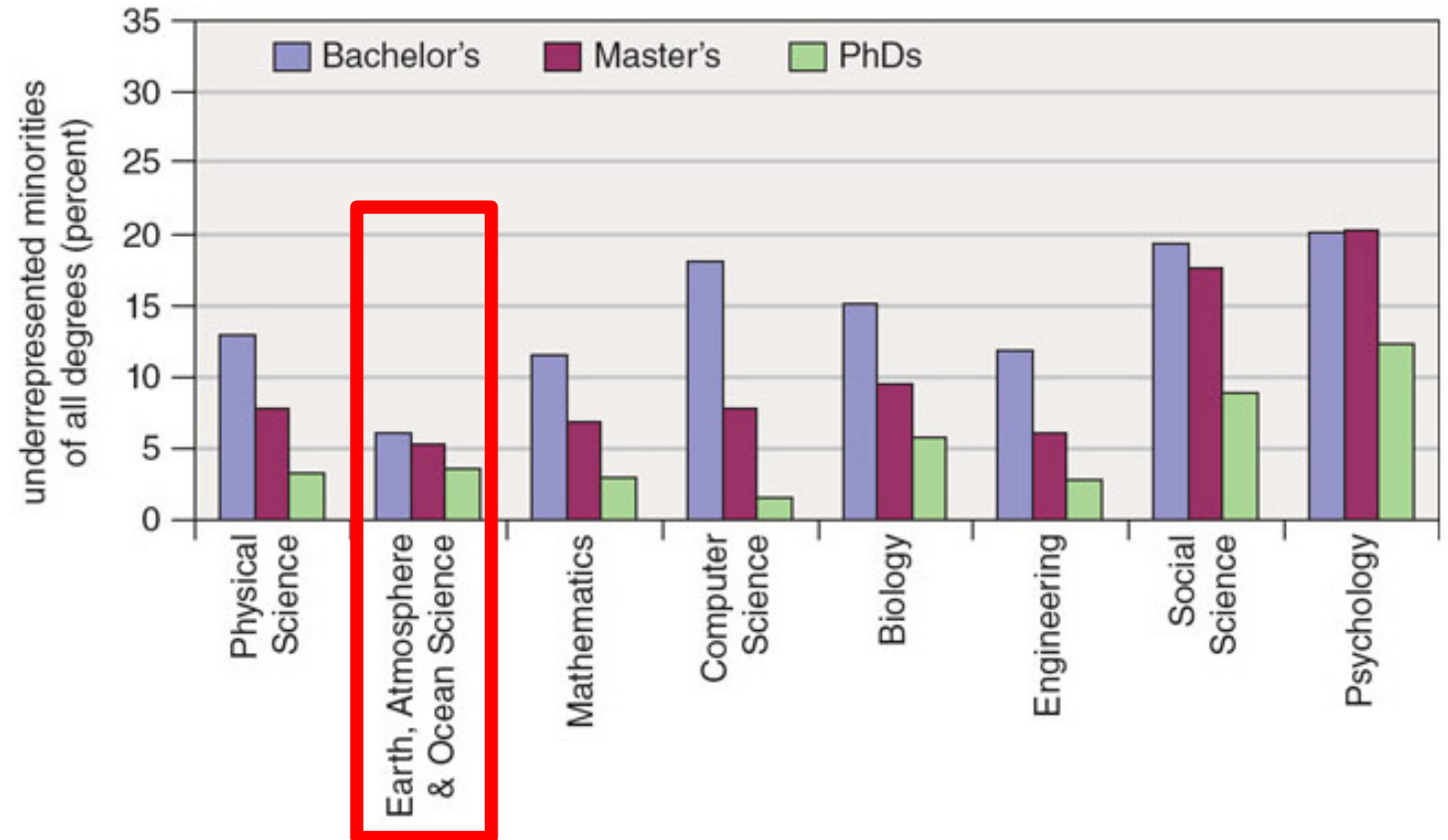
# Trends in the Geosciences

## Gender



AGI Currents, 2017

## Ethnicity and Race



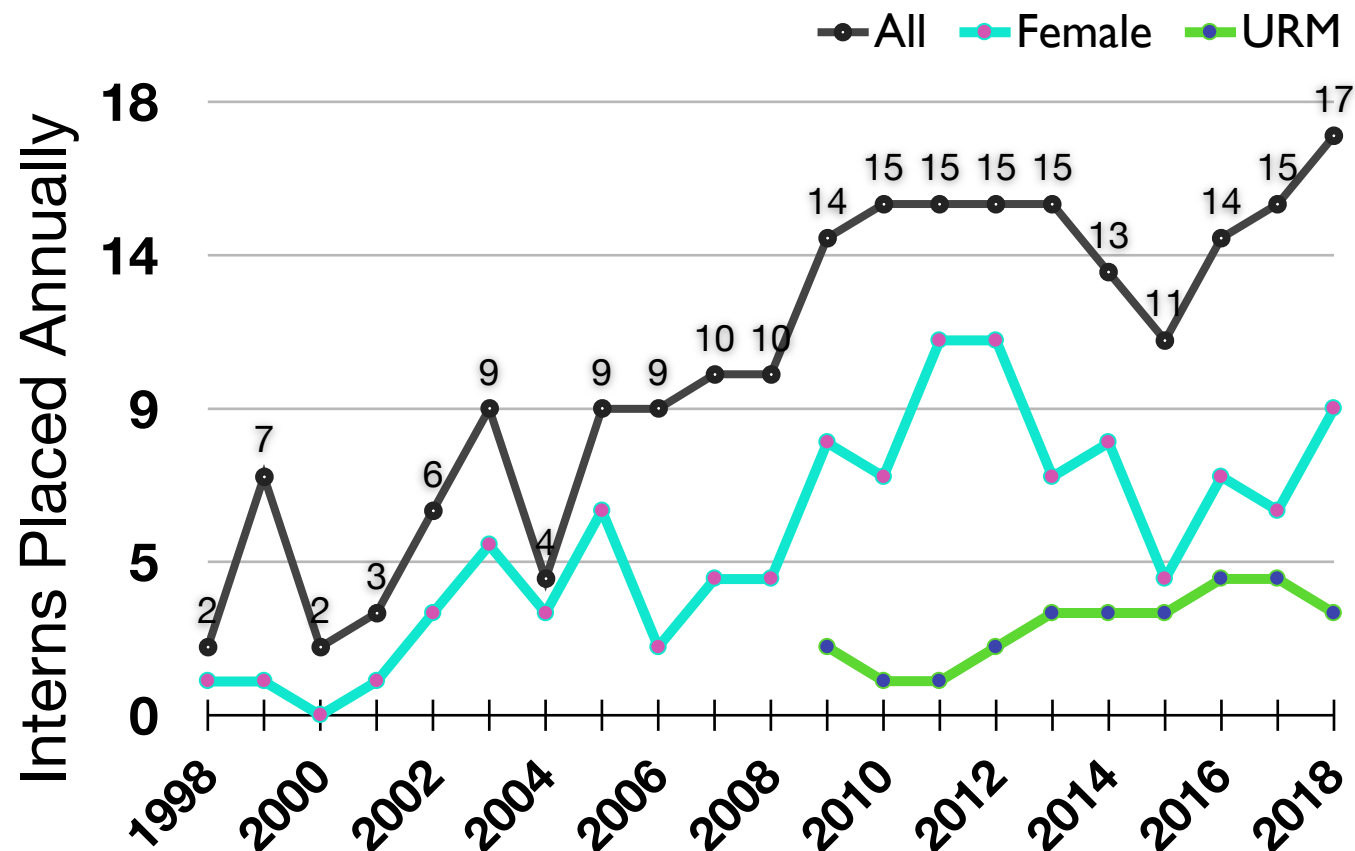
<https://www.americanscientist.org/article/how-to-recruit-and-retain-underrepresented-minorities>



# Internship Program

## Summer Intern Program

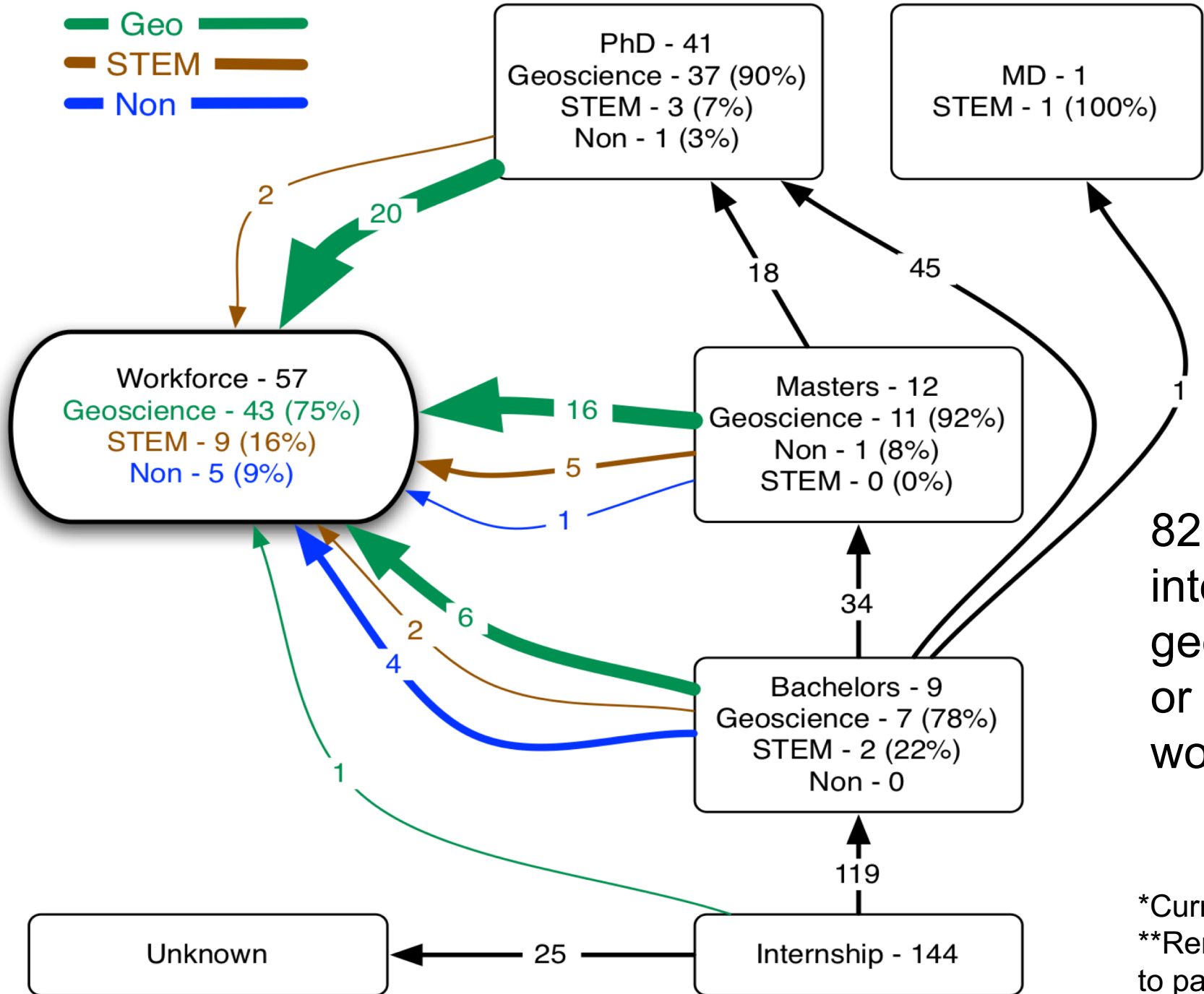
- 1 week orientation
- Independent research guided by science mentor
- Presentation at Fall AGU
- Alumni mentor facilitation
- Exposure to multiple scientists, staff, and industry professionals



URM include Hispanics, Blacks/African Americans, and Native Americans



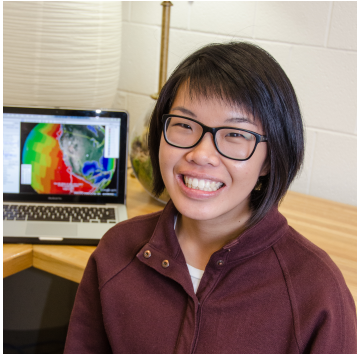
# Program Success and Outcomes



82% of former interns are pursuing geoscience degree or in the geoscience workforce

\*Currently being updated  
 \*\*Reminder to all alumni present to participate in the survey

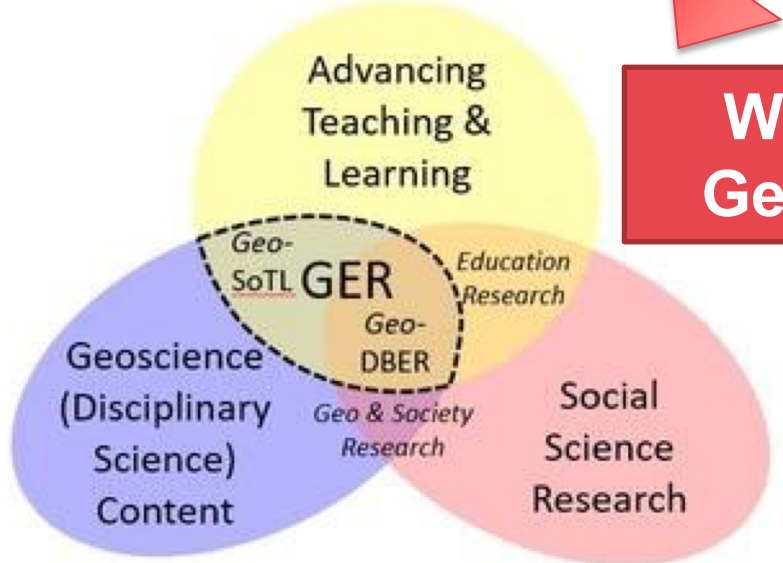
# My Own Pathway



PhD Geoscience



Workforce Geoscience



TODAY: Combine Interests in Seismology and Geoscience Education Research (GER)

BA Geoscience



IRIS Intern '07

# Measuring Intern Program Outcomes

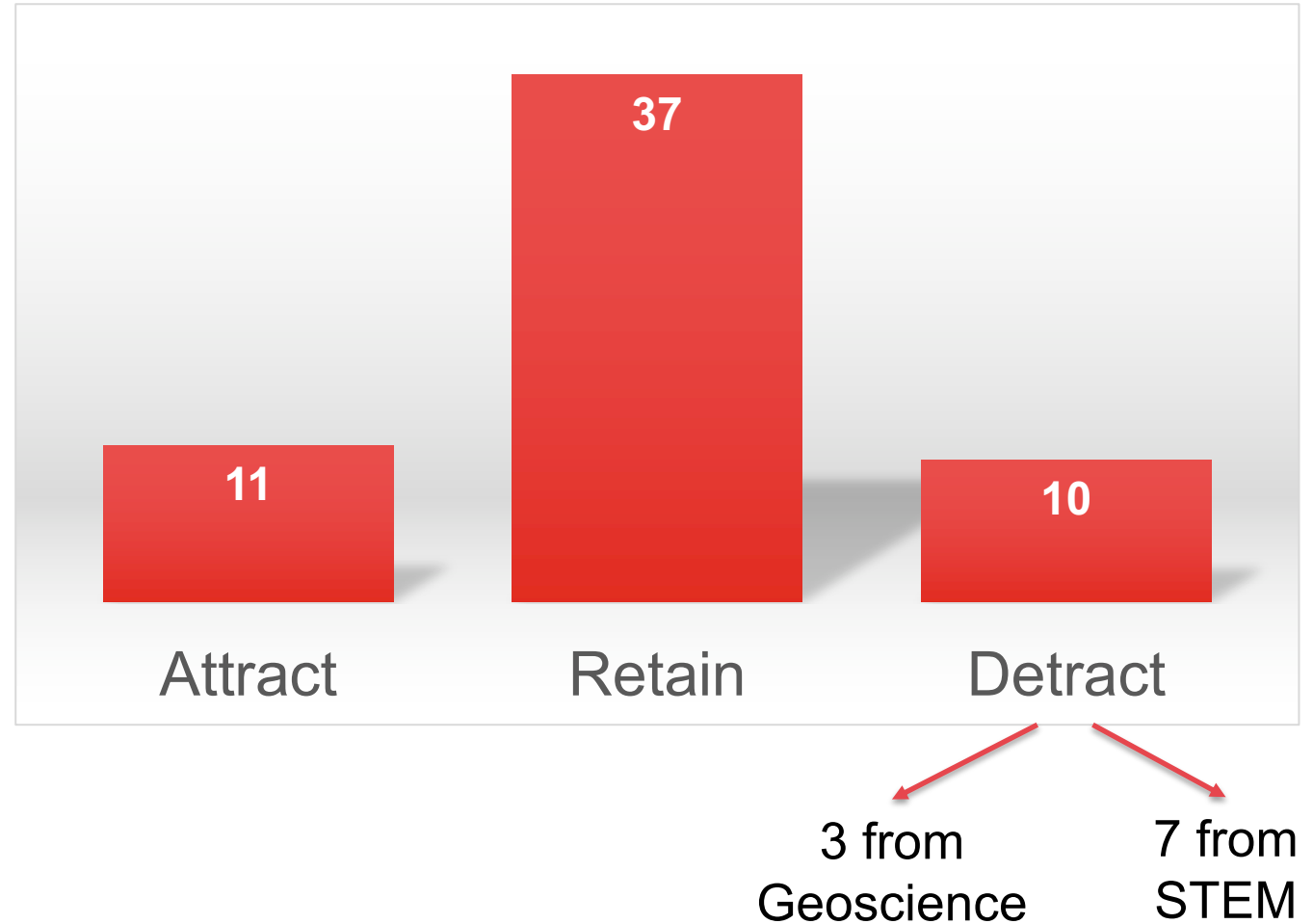
- Program influence on participants
- Assumes pre internship major is indicative of commitment to pursue an advanced degree/career in the geosciences
- Three different effects were determined from post participation surveys of program alumni



Effect	Description
Attract	Participants whose majors were <b><i>not geoscience but ultimately pursued</i></b> grad school or a career in the geosciences
Retain	Participants whose major was geosciences and <b><i>they continued</i></b> to pursued grad school or a career in the geosciences
Detract	Participants who, <b><i>regardless of major, ultimately decided to not pursue</i></b> grad school or a career in the geosciences

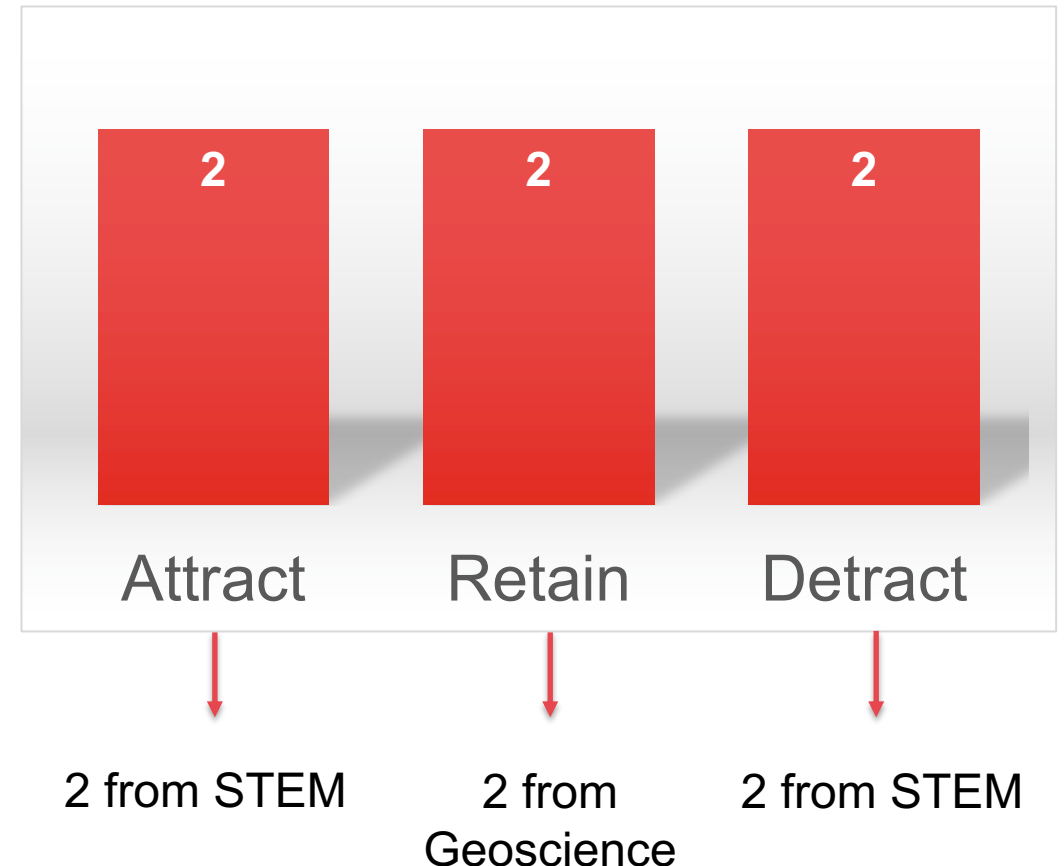
# Attract, Retain, and Detract

- 48 out of 58 (83%) interns earn a geoscience degree or enter a geoscience career
- From STEM, we are able to attract about half of the participants into the geosciences



# Attract, Retain, and Detract - URM

- 6 URM tracked participants from 2010-2014
  - URM is defined as Hispanic, Black, and Native American
- Small numbers currently, but 66% of URM in IRIS internship earn a geoscience degree and pursue a geoscience career
- More recent data includes larger numbers of URM and those from geoscience backgrounds



# Attracting and Supporting STEM

## Geoscience Career Score

- If I want to, **I can become a geoscientist.**
- As a result of this internship, **my desire** to pursue a career
- As a result of this internship **I will seek a career** in a field

## Group Dynamic Score

- **I enjoy communicating with the members** of the group
- There are feelings of **unity and togetherness** among the group
- During the summer, I had **opportunities for positive interactions** with other students and researchers at my PI's institution

	GCS Range: 3-13		Group Dynamic Range: 23-43	
	Mean	SD	Mean	SD
Attract	12.1	1.3	34.7	4.5
Detract	8	2.2	34.9	7.9

- Tracked Data, 2010-2014 (n=21)



# Attracting and Supporting STEM

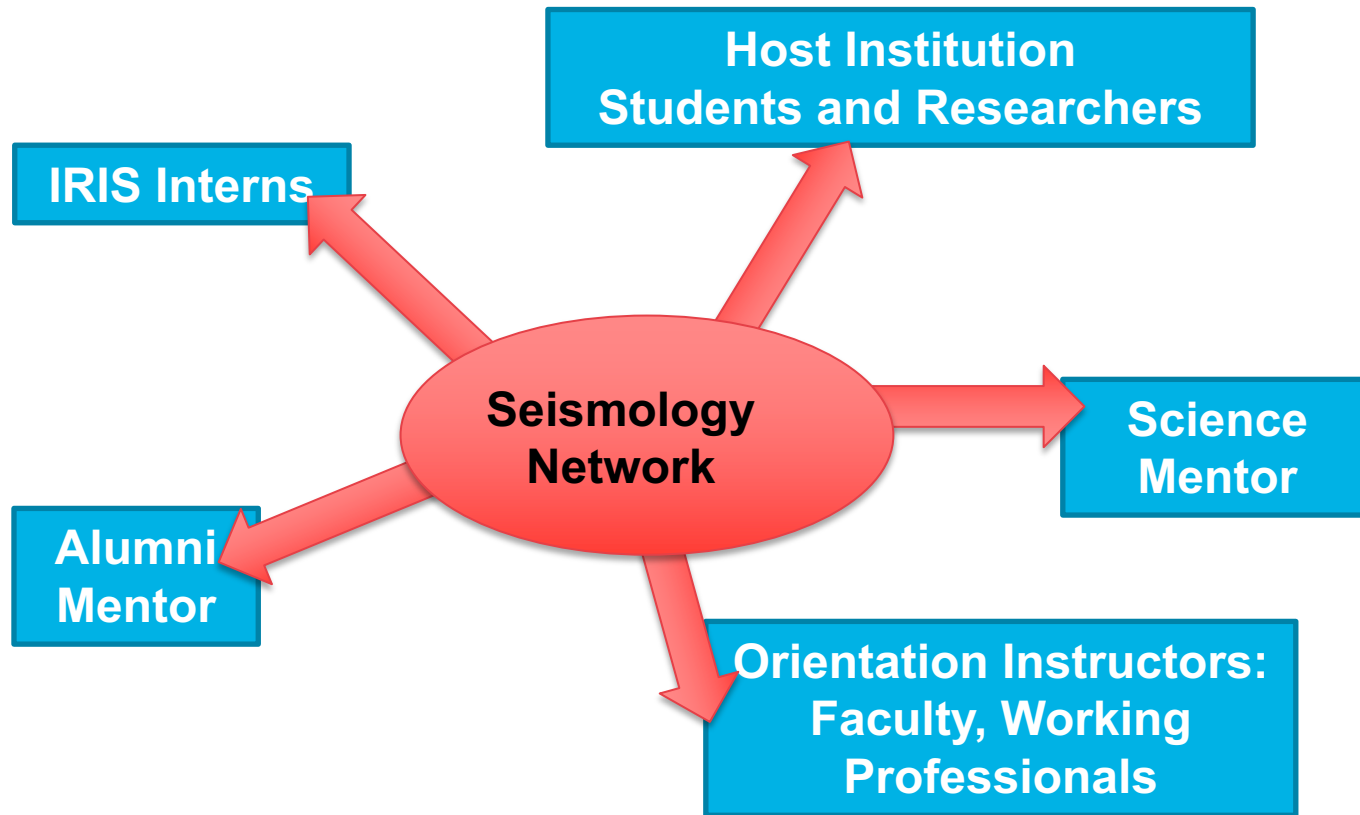
	Female   Junior   STEM ATTRACT	Female   Junior   STEM ATTRACT	Female   Soph   STEM DETRACT
Excerpt	<p>I had absolutely no idea what I was going to do with my physics degree. <b>I loved my internship project... I will be applying to geophysics graduate programs this fall.</b> My research mentor has also influenced my decisions and it is comforting to have someone who can <b>guide me through</b> the graduate school process. I think it was <b>important to meet with the other interns</b> and be able to <b>share our fears and expectations.</b></p>	<p>My <b>research project affirmed that I want to study</b> physical oceanography or marine geophysics in graduate school and continue to do research in the future. Our Facebook group, blog, and cell phones <b>allowed us to communicate with each other and give each other support</b> when we were frustrated by our research despite being spread out all over the country and unable to lend a hand in person.</p>	<p>This internship helped me get a <b>sense of what my life would be like as a researcher</b> in the geosciences, both as a P.I or collaborator. I felt that I got a real sense of what life is like in the field, at the University, and everything outside of work. Its given me some serious pros and cons for entering academia versus industry although I have yet to make a real decision.</p>
Coded	<p>Positive Experience            Connection with Geoscience Content            Desire and Interest            Mentor Trust            Comradery and Support</p>	<p>Desire and Interest            Comradery and Support</p>	<p>Vicarious Experience            Moderate Interest</p>

# Attracting and Supporting URM

	Female   Junior   Geo Group Dynamic = 39 RETAIN, Pursue PhD	Male   Senior   STEM Group Dynamic = 38 ATTRACT	Junior   Male   STEM Group Dynamic = 33 DETRACT	Female   Junior   STEM Group Dynamic = 26 UNKNOWN
Excerpt	<p>The most meaningful part of my experience... was the <b>wonderful sense of community</b> that the program fostered. From my fellow interns to my summer research group to the seismology community as a whole, I feel like <b>I've made lifelong professional connections</b>. Very <b>useful advice from current and recent grad students</b> about practicalities of student research.</p>	<p>The interns revealed to me that I would <b>always have someone to depend on or talk to</b> once I run into an obstacle or just need to talk to someone. [Other students and researchers at my host institution] provided me with refuge, <b>information and general knowledge about the culture of the community</b>.</p>	<p>Many of the <b>interns had similar worries</b> and that helped ease the nerves.</p>	<p>I was able to obtain <b>meaningful team building experience</b>.</p>
Coded	Comradery and Support Vicarious Experience	Comradery and Support Vicarious Experience	Comradery and Support	Comradery and Support



# Social Capital and Diversity



- Social capital lens to understand diversity
  - Increase “sense of belonging” → improved performance of diverse groups
- Building trustworthy relationships
  - Resources
  - Role Models


Callahan, C., et al., 2015

**INTERN QUOTE:** [I]t was inspiring to talk to **people from so many different backgrounds** who have all found their way to rewarding careers. ...This internship also showed me that there are **many opportunities outside of academia where I could see myself** in the future.


# IRIS Internship Program

Growing interest to not only document undergraduate research opportunity outcomes, but also **researching a better understanding of why those outcomes occur** (e.g. Linn, et al., 2015, Robnett, et al., 2015)


- Specific populations, Longitudinal studies
- Justify and optimize financial and staff resources that support undergraduate research programs



IRIS internship program **has rich data set to explore variables** associated with program outcomes



**Strong track record of students pursuing geoscience** degrees and careers



Exploring other variables like **Geoscience Career Score and Group Dynamic Score** can show us **potential influences on outcome**

Opportunities to look more closely at quality of mentoring, skill development, conference presentations

# Seismology and GER Collaborations

How can we apply the results of the IRIS internship program to our own institution?

- **Grow science and geoscience identity**
- **Build social capital** - expose students to multiple mentors, role models, and resources

## At UIC – Peer Mentors

- Highlight student paths into geoscience
- Blog sharing advice and guidance



## IRIS Mentee Resource

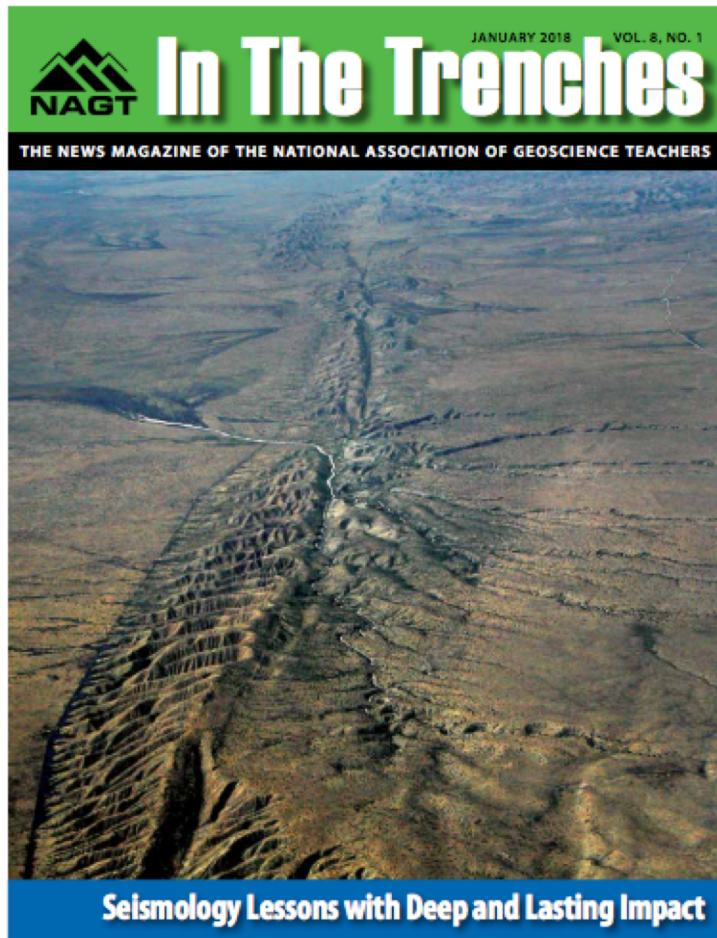
### Self-Reflection Guide

The IRIS Internship program seeks to enable interns to develop both the practical skills and intellectual proficiencies required of independent geophysics researchers. To facilitate interns' progress towards



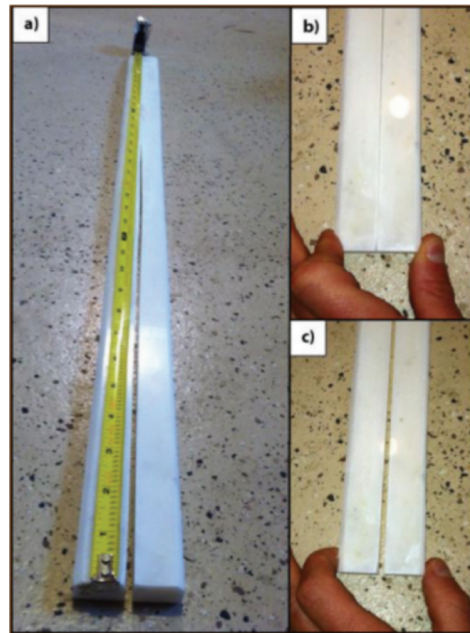
[https://www.iris.edu/hq/internship/self\\_reflection](https://www.iris.edu/hq/internship/self_reflection)

# Seismology and GER Collaborations

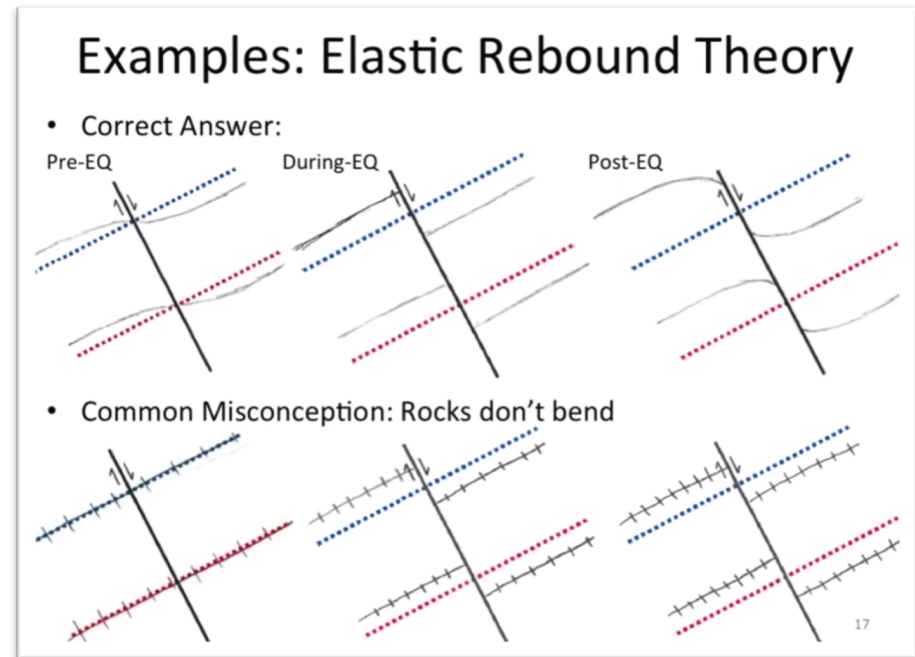


## Using Models to Develop Deep Understanding of Earthquakes

LaDue et al., 2018



Michael Hubenthal

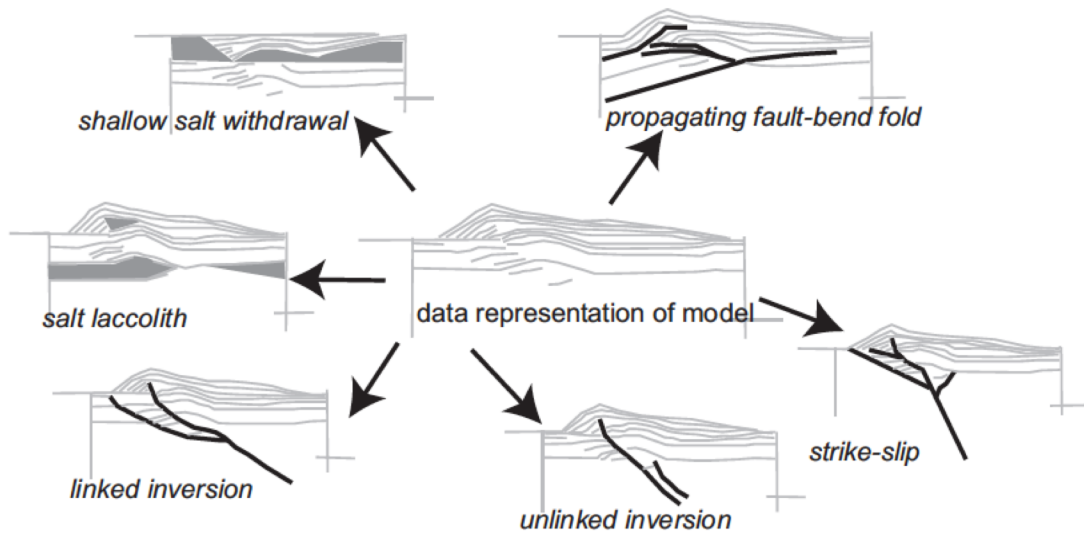


Michael Brudzinski



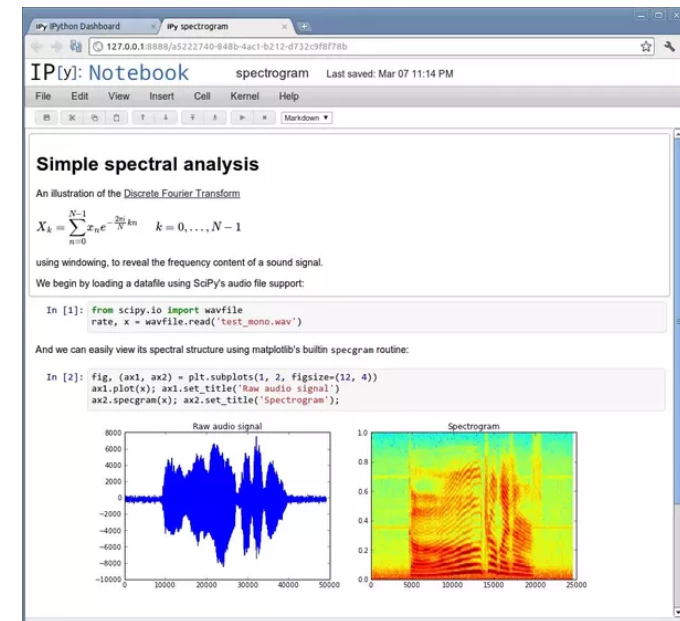
# Seismology and GER Collaborations

What do you think this is? “Conceptual uncertainty”  
in geoscience interpretation



Bond et al., 2007

A Python Library for Teaching  
Computation to Seismology Students



Aiken et al., 2018

# Seismology and GER Collaborations

- Collaborations between seismologists and education researchers can make **BOTH COMMUNITIES STRONGER**
- We should be stakeholders in these questions:
  - 1) Are you worried about building students' abilities to **Problem Solve, Use Quantitative Reasoning, and Understand Models**
  - 2) Are you interested in the **Access and Success of All Students and Especially Under-Represented Groups in the Geosciences**
  - 3) Have you thought about new **Instructional Strategies to Improve Geoscience Learning in Different Settings and with Different Technologies**

# RESOURCES

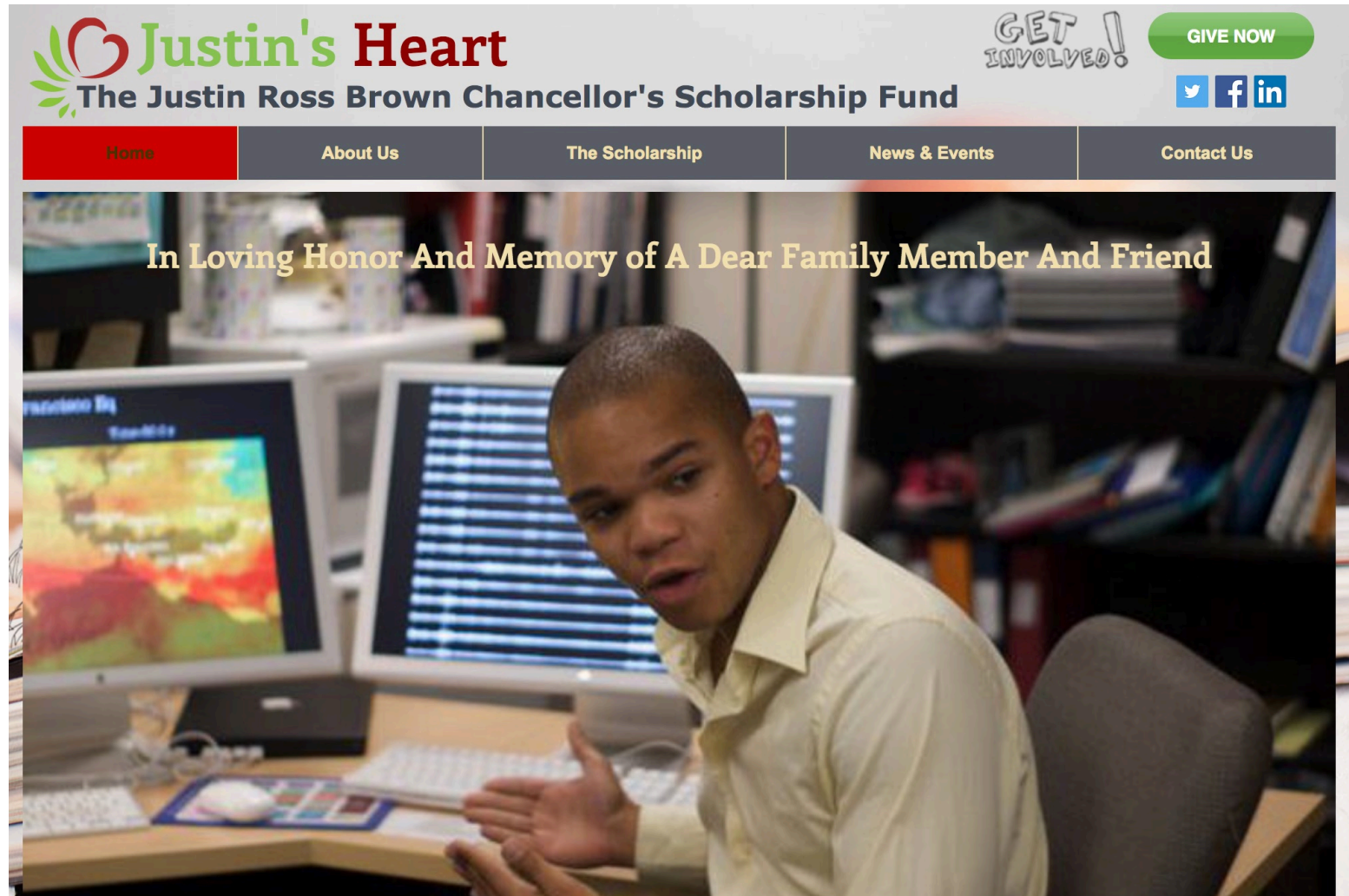
- Science Education Resource Center - <https://serc.carleton.edu/index.html>
- International Association for Geoscience Diversity - <https://theiagd.org/>
- Out in STEM - <https://www.ostem.org/>
- Journal of Geoscience Education, Special Issue Broadening Participation - <https://tandfonline.com/toc/ujge20/55/6> (upcoming special issue in the next year)

# In Honor and Memory of Justin Brown

Justin was known for being smart, outgoing, and having an exuberant personality. Justin was an Ironman athlete, a talented musician, and a geophysics professor.

Justin was an IRIS intern in 2004 and gave several seminar talks advertising the program to help attract students from underrepresented groups.

[www.justinsheart.org/](http://www.justinsheart.org/)



**Justin's Heart**  
The Justin Ross Brown Chancellor's Scholarship Fund

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In Loving Honor And Memory of A Dear Family Member And Friend