Triggering Epicenters in Geoscience: Fostering the Next Generation of Seismologists

Stefany Sit\textsuperscript{1} and Michael Hubenthal\textsuperscript{2}
June, 2018, IRIS Workshop – ABQ
\textsuperscript{1}Univ of Illinois at Chicago, \textsuperscript{2}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

→ IRIS Internship Program has been working to address Access and Success
Trends in the Geosciences

Gender

<table>
<thead>
<tr>
<th>Percentage of Graduates</th>
<th>Male</th>
<th>Female</th>
<th>NonBinary</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td></td>
<td></td>
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<tr>
<td>30%</td>
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<td></td>
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<tr>
<td>20%</td>
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</tr>
<tr>
<td>10%</td>
<td></td>
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</table>

Ethnicity and Race

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

AGI Currents, 2017
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
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

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

IRIS Intern ‘07

PhD Geoscience

Workforce Geoscience

BA Geoscience
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

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

![Diagram showing numbers for Attract, Retain, and Detract categories]

- Attract: 11
- Retain: 37
- Detract: 10

- 3 from Geoscience
- 7 from STEM
• 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

<table>
<thead>
<tr>
<th></th>
<th>GCS Range: 3-13</th>
<th>Group Dynamic Range: 23-43</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Attract</td>
<td>12.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Detract</td>
<td>8</td>
<td>2.2</td>
</tr>
</tbody>
</table>

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

I had absolutely no idea what I was going to do with my physics degree. **I loved my internship project... I will be applying to geophysics graduate programs this fall.** My research mentor has also influenced my decisions and it is comforting to have someone who can **guide me through** the graduate school process. I think it was **important to meet with the other interns and be able to share our fears and expectations.**

### Coded

<table>
<thead>
<tr>
<th>Positive Experience</th>
<th>Connection with Geoscience Content</th>
<th>Desire and Interest</th>
<th>Mentor Trust</th>
<th>Comradery and Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Junior</td>
<td>STEM</td>
<td>ATTRACT</td>
<td>Female</td>
</tr>
</tbody>
</table>

| My research project affirmed that I want to study physical oceanography or marine geophysics in graduate school and continue to do research in the future. Our Facebook group, blog, and cell phones allowed us to communicate with each other and give each other support when we were frustrated by our research despite being spread out all over the country and unable to lend a hand in person. |

| This internship helped me get a sense of what my life would be like as a researcher 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. |

<table>
<thead>
<tr>
<th>Desire and Interest</th>
<th>Comradery and Support</th>
<th>Vicarious Experience</th>
<th>Moderate Interest</th>
</tr>
</thead>
</table>
## Attracting and Supporting URM

<table>
<thead>
<tr>
<th>Excerpt</th>
<th>Comradery and Support Vicarious Experience</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Junior</td>
<td>Geo</td>
<td>Group Dynamic = 39</td>
<td>RETAIN, Pursue PhD</td>
</tr>
<tr>
<td>The most meaningful part of my experience… was the <strong>wonderful sense of community</strong> that the program fostered. From my fellow interns to my summer research group to the seismology community as a whole, I feel like I've made lifelong professional connections. Very <strong>useful advice from current and recent grad students</strong> about practicalities of student research.</td>
<td>The interns revealed to me that I would <strong>always have someone to depend on or talk to</strong> 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, <strong>information and general knowledge about the culture of the community</strong>.</td>
<td>Many of the interns had <strong>similar worries</strong> and that helped ease the nerves.</td>
<td>I was able to obtain <strong>meaningful team building experience</strong>.</td>
<td></td>
</tr>
</tbody>
</table>
• Social capital lens to understand diversity
  – Increase “sense of belonging” → improved performance of diverse groups

• Building trustworthy relationships
  – Resources
  – Role Models

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.
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
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 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 Brudzinski

Examples: Elastic Rebound Theory

- Correct Answer:
  - Pre-EQ
  - During-EQ
  - Post-EQ

- Common Misconception: Rocks don’t bend

Michael Hubenthal
Seismology and GER Collaborations

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

A Python Library for Teaching Computation to Seismology Students

Bond et al., 2007

Aiken et al., 2018
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/