

Annual Report

REU Site: Leading Undergraduates in Challenges to Power Academic Development in Geosciences

Project/Grant Period: 9/01/2014 - 08/31/2016

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Principal Investigator: Donna J. Charlevoix

Co-Principal Investigator: Aisha R. Morris

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Project Goals

The REU Site: Leading Undergraduates in Challenges to Power Academic Development in Geosciences (a.k.a Geo-Launchpad Program), is a summer research internship supported by the National Science Foundation under Award No. 1359469. The Geo-Launchpad Program is dedicated to increasing the diversity of students entering the geosciences. Geo-Launchpad helps students develop research-ready skills, and provides support in creating a career path in science, engineering, or technology. Interns are students in their first two years of post-secondary education (students from two-year colleges) and freshmen and sophomores from four-year colleges). Interns spend eight weeks at UNAVCO in Boulder, Colorado, working on a collaborative project under the guidance of an UNAVCO project manager, culminating in a poster presentation. A Faculty Mentor from their home institution provides guidance and support before, during, and after the program. The program has four primary goals:

- Goal 1: Serve lower-division university and community college students from underrepresented groups
- Goal 2: Build student interest in geosciences and related careers
- Goal 3: Engage students in collaborative research projects in the geosciences that develop and improve research-ready skills
- Goal 4: Provide ongoing support for students choosing to pursue degrees in geosciences and related fields

Accomplishments

Major Activities

The primary activity of the Geo-Launchpad Program is to provide a summer internship experience for students early in their academic career (within the first two years) and from groups traditionally underrepresented in the geosciences. The focus of the internship is on the development of 'research-ready' skills. The focus of broad skills development versus conducting scientific research sets this internship apart from most other summer internship experiences. Interns spent the summer in Boulder, Colorado working with UNAVCO technical staff and participating in a multitude of programmatic activities. The 2015 intern cohort was the first for the Geo-Launchpad program; this was a pilot year. There were seven key elements to the experience.

1. Research Support Project. Interns worked collaboratively in pairs on a research support project under the direct supervision of UNAVCO technical staff. Students were provided office space within the UNAVCO facility and any required computing resources and supplies. The first week of the experience included technical training needed to perform their duties.
2. Geology Field Trips. Interns participated in two geoscience field trips. They joined 14 other interns working at UNAVCO to learn about Colorado geology including Red Rocks, Morrison, and Dinosaur Ridge. Interns joined the RESESS interns (Research Experiences in Solid Earth Science for Students) on an overnight field trip to the University of Colorado (CU) Mountain Research Station. The field trip was led by graduate students from the Department of Geology at CU. Interns learned about local geology and graduate school.

3. Communications workshop. Interns participated in a weekly workshop explore non-academic, formal and informal communications as a student and a scientist.
4. Career Circles. Over lunch every other Wednesday, guest speakers from different geo-workforce sectors met with interns and discussed their jobs and personal career trajectories. The informal setting and question and answer period allowed interns to learn details about different careers in industry, government, academia and non-profit organizations.
5. Skills Seminar. Interns met weekly for a skills seminar that provided training on topics including organization, time management, and basics of various types of software.
6. Communications with Faculty Mentors. Interns communicated with faculty mentors throughout the summer sharing work highlights and internship summaries. This allowed their faculty mentors to stay abreast of the intern's experiences.
7. Work project dissemination. Students presented their work in a UNAVCO colloquium streamed live online. They also presented posters at an intern research symposium at UNAVCO with over 60 other Boulder area interns.

Faculty Mentorship. Within the Geo-Launchpad Program, a complement to the intern program is faculty mentorship and training. It is critical that interns have a strong and supportive relationship with a faculty member from their home institution in order to ensure they continue on a path to a career in science. All interns applied with a Faculty Mentor who provided support before, during, and after the internship. Faculty mentors were asked to:

- Write a letter of recommendation for the student as part of their application.
- Regularly communicate with the intern about their research throughout the summer.
- Travel to UNAVCO in Boulder on July 29th and 30th to receive mentoring training and attend the interns' final oral and poster presentations.
- Conduct one official meeting with their student in fall 2015 during which time they discuss topics such as career paths, opportunities on campus, and how to stay connected to the scientific community. The student submits a summary of the meeting to the Geo-Launchpad program staff after which faculty receive an honorarium for their participation. Faculty were encouraged to meet with students regularly throughout the year, but it was not required as part of the Geo-Launchpad program.

Specific Objectives

Data were collected by an external evaluator to see if program objectives were met. The evaluation included formative and summative elements and was conducted using mixed-method measures (pre-post surveys, observations, interviews and focus groups). Overall, program goals and objectives were met.

The pilot Geo-Launchpad program was highly successful, adding to UNAVCO's history of success in running internships. The four selected students exhibited great enthusiasm and a strong work ethic, and the six UNAVCO staff mentoring the projects were equally enthusiastic and engaged in the program. Key evaluation findings are summarized

below. Data were collected using a modified version of the Undergraduate Research Student Self-Assessment (URSSA) instrument (Hunter, Weston, Laursen & Thiry, 2009). The URSSA was developed with funding from the National Science Foundation to assess students' personal, professional, and intellectual outcomes from participating in undergraduate research, including REU experiences. Because Geo-Launchpad is not a research internship, items were adapted to better fit the technical and field work of the Geo-Launchpad internship. The survey evaluates gains in particular areas on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree). Survey scales have been modified from the original version to better match the focus and goals of the GLP internship. Survey scales include *networking/collaboration*, *intellectual gains*, *scientific communication*, *organizational skills*, *technical skills*, *career knowledge* and *career preparation*. The survey also measures other aspects of the internship experience, including the impact of the internship on students' educational and career aspirations.

Skills gains

- Students' highest reported gains were in technical skills/instrumentation (survey mean rose from 2.25 to 3.63 on a 5-point scale).
- Students' perceived knowledge and skills rose substantially on all survey scales (including technical skills, scientific communication skills, organizational skills, intellectual gains, career knowledge and career preparation), although students' perceived ability to work in teams fell slightly.

Career knowledge and preparation

- In interviews, students noted the profound impact that the Geo-Launchpad internship had on their career knowledge and direction. Two out of the four students began to seriously consider new career paths or fields of study because of their exposure to these options during the Geo-Launchpad internship. The other two students strengthened their commitment to their pre-existing goals, and one of these students began to more seriously consider graduate school.
- All students reported that their knowledge about geoscience careers increased substantially (e.g., survey mean increased from 3.25 to 4.5 on a 5-point scale).
- All students felt more prepared to study geoscience at a 4-year institution (e.g., survey mean increased from 4.0 to 4.5 on a 5-point scale).

Scientific communication skills

- In interviews, students reported that they had a better understanding of scientific language and scientific communication practices (e.g., posters, understanding journal articles).
- All students reported increased scientific communication skills on the survey, particularly knowing how to prepare a scientific poster (e.g., survey mean increased from 2.5 to 4.5 on a 5-point scale).

A discussion of specific objectives follows.

Goal 1: Serve lower-division university and community college students from underrepresented groups

Objective 1.1 Increase target population awareness of the Geo-Launchpad program within the Colorado region

Objective 1.2 Attract an applicant pool that is aligned with program goal

In all, 30 university or community college students applied for the Geo-Launchpad internship in 2015. The target population was community college students and students not yet starting their junior year at four-year colleges. In particular we were interested in engaging students from these populations that were also from groups traditionally underrepresented in the geosciences. Application review criteria were developed based on similar internship programs as well as input from the community college faculty consultant to the program. Review criteria included:

- enrollment in a Community College, or be enrolled in a four year university but not yet started their Junior year,
- a cumulative GPA of 3.0 or higher,
- completed College Algebra (minimum grade of B),
- completed at least one additional course in geology, physical geography, hydrology, environmental sciences, physics, math, geophysics or engineering (minimum grade of B),
- a Faculty Mentor from their home institution willing to support them before, during, and after the internship,
- interest in career paths involving science, technology, or engineering
- U.S. citizenship or permanent residence status, and
- comfort with the internship requirements including living in Boulder, Colorado for the summer.

Almost all of the applicants met all or some of the review criteria. Four students were selected to participate in the program. Three were enrolled at community colleges and one was enrolled at 4-year University. Additionally, three of the students were female and one was male. Two were enrolled part-time at their institutions, while the other two were full-time students.

All three community college students plan to transfer to 4-year institutions; in fact, one of them will be a student at University of Texas, Austin this fall.

- Three of them work outside their studies—one works full-time and the other two work part time. One is a lab assistant, one is a dining hall employee and the other did not report.
- One student is a returning adult student with a family.
- Students also had diverse ethnic backgrounds – one reported she is white, while the other three were multi-racial (reporting white/Hispanic, Hispanic/Asian, and white/American Indian ethnicities).

Goal 2: Build student interest in geosciences and related careers

Objective 2.1: Increase student awareness of diversity of geoscience-related careers

Objective 2.2: Increase student awareness of necessary skills to pursue geoscience-related careers

Objective 2.3: Increase student awareness of necessary academic preparation to pursue particular geoscience-related careers

Interns in these early stages of their academic career often do not know what career options are available in geosciences. In particular, the geosciences (geology in particular) are often promoted as working out in a field examining rock structures. The Geo-Launchpad internship aimed to expose students to many potential career paths in geosciences as well as the steps they would need to take in order to pursue such careers after their academic studies. In a post-summer evaluation (Figure 1), interns reported very strong gains in career knowledge from their summer experience. In particular, gains in understanding geoscience career options and awareness of the resources to learn about careers. Interns also reported strong gains in understanding the skills necessary to pursue geoscience careers. Interns demonstrated moderate growth in understanding the everyday work of geoscientists.

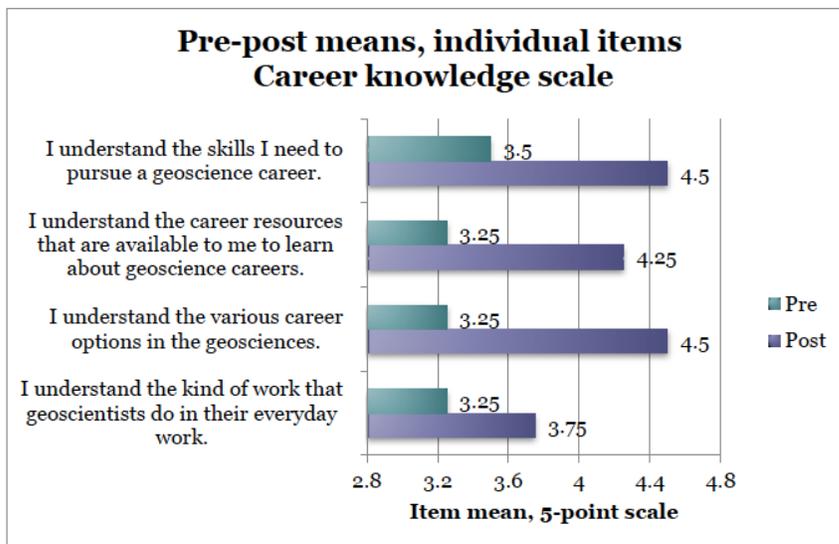


Figure 1. Geo-Launchpad intern responses to geoscience career knowledge survey questions.

Interns were also asked to provide input on geosciences career preparation (Figure 2). They felt reasonably well prepared for careers when they started the summer program. However, they still made some gains in educational and career preparation. They showed the most growth in feeling ready to study geoscience at a 4-year institution. Interns' belief that they could be successful in a geoscience career also increased.

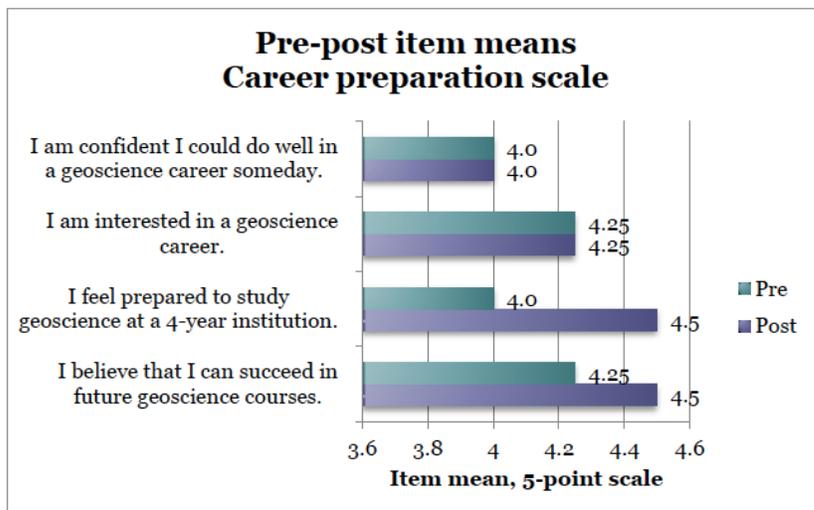


Figure 2. Geo-Launchpad intern responses to geoscience career preparation survey questions.

Goal 3: Engage students in collaborative research projects in the geosciences that develop and improve research-ready skills

Objective 3.1: Improve students' research skills

Objective 3.2: Improve students' ability to communicate scientific content to scientific and non-scientific audiences

Objective 3.3: Increase students' geoscience content knowledge

Unlike traditional Research Experiences for Undergraduate programs, the Geo-Launchpad program was designed to help students develop the skills needed to conduct research in the future. A significant part of the scientific enterprise requires is working collaboratively and having a skill set that allows for advancement of ideas and experiments. Interns began the summer program with strong beliefs in their organizational skills, however, their skills still increased over the summer. They reported the most gains in project organizational skills and their ability to work independently. Time management skills remained steady during the summer.

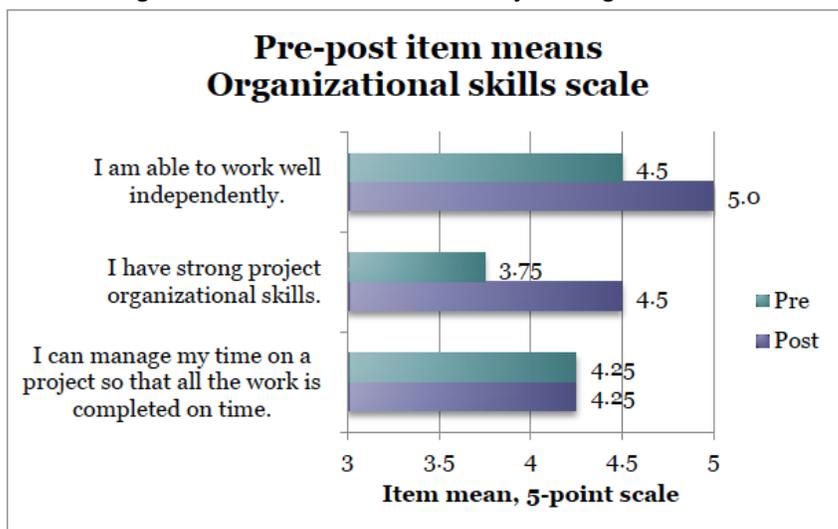


Figure 3. Geo-Launchpad intern responses to organizational skills survey questions.

Goal 4: Provide ongoing support for students choosing to pursue degrees in geosciences and related fields

Objective 4.1: Increase student awareness of student support resources

Objective 4.2: Increase student awareness of career resources

Objective 4.3: Increase student confidence in networking abilities

A key element of the Geo-Launchpad program is student support before, during and after the summer internship. The summer program helped students develop networking skills so they would be able to develop their own support networks as they moved through their academic career. In pre-post surveys, interns' beliefs about the importance of networking and their comfort in networking with geoscientists remained steady, with interns scoring quite high (4.75 and 3.75 respectively) on the pre-survey. Students' perceived ability to collaborate fell during the internship from 4.0 to 3.24. We hypothesize that this is related, in part, to a professional conflict over work tasks reported by one of the intern teams. In addition, interns initial comfort level may have been higher due to the new experience of collaborate in a work environment, which is very different from collaboration in an academic setting.

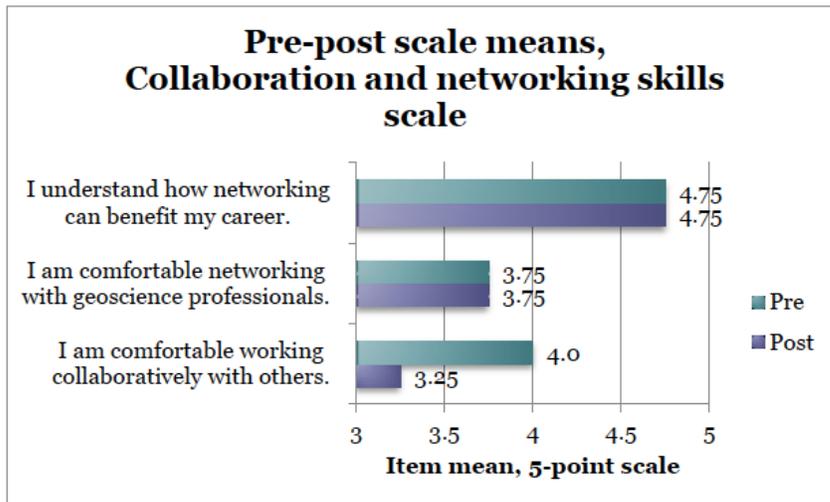


Figure 4. Geo-Launchpad intern responses to collaboration and networking survey questions.

Significant Results

Four significant findings emerged upon reflection of programmatic activities: value of near-peer mentoring with other UNAVCO intern programs, faculty mentor involvement, engagement of UNAVCO staff, and programmatic staff time demands.

Near-peer mentoring. The ability to network and interact with other interns was extremely beneficial. The Geo-Launchpad program was one of three internship programs managed by UNAVCO during the summer of 2015. Summer activities were designed to facilitate and encourage interactions between the internship participants, both professionally and socially. Interns participating in the RESESS internship program are upper classmen or recent university graduates. RESESS interns spent the summer working in nearby academic labs conducting authentic research. RESESS and Geo-Launchpad both had housing accommodations at the University of Colorado. Interns in the UNAVCO Summer Internship Program (USIP) were primarily graduate students or

university students nearing graduation. The USIP interns worked on UNAVCO-related projects under the direct supervision of UNAVCO staff.

Geo-Launchpad interns reported they felt more prepared to participate in a summer research internship as a result of interactions with RESESS students.

In some ways I feel more prepared for research. I think even just interacting with some of the RESESS Interns and seeing what they're doing. It was really neat to see what other research is being done.

Faculty mentors reported observing a connection between the Geo-Launchpad interns and RESESS interns, seeing the RESESS interns as role models for the Geo-Launchpad interns.

The connections that she has made here are fantastic and learning, especially, I think, they really had a close relationship with the RESESS students who were from everywhere.

Faculty engagement. Requiring a faculty mentor to apply with and interact with interns is important. Interns are very early in their academic careers. Requiring a faculty member to apply with the intern provided a touchstone for interns at their home institution. The primary goal of involving faculty was so that students had another point of contact for sharing successes and challenges. These faculty mentors provide continuity for students, engaging with them before, during and after the program. Unexpectedly, faculty mentors self-reported an impact on themselves by participating in the program. Faculty were re-energized and appreciated the opportunity to engage with students and other faculty in a way not typically available to them. From one faculty mentor:

I think for me personally, I've been teaching a very, very long time. This will start my 32nd year. You get kind of cranky and old. This is just like, oh this is so cool. We talked a minute ago about her coming to my class. I have a geology majors class and her coming and talking about this program and opportunities that she's had. That gets me all excited and energetic, ready to go. So I got a lot out of it. I'm getting a lot out of it still.

Another faculty mentor commented:

It gave me a good opportunity to meet up with other people who, as it turns out just coincidentally, were also research mentors of students. I knew them already and they had projects going here, so it was great for me to connect with a few people as well. Being here has been really great. Also, making contact with people at some of these community colleges; that's a resource, that I don't really have access to right now.

UNAVCO staff involvement. UNAVCO staff involvement and support is key. The premise of the Geo-Launchpad program is two-fold: (1) provide students experience and exposure to work of supporting scientific research and (2) provide UNAVCO staff additional support during the summer to complete their own work projects. UNAVCO technical staff directly supervised interns'; the success of the program hinges on the quality of this interaction and the productivity of the interns. UNAVCO technical staff were enthusiastic and engaged in the process, taking time to work with interns and make adjustments along the way as necessary. Interns reported seeing their UNAVCO manager as a mentor.

UNAVCO mentors were helpful. Our Lead, we didn't see him as much, the other others were right there with us and anything we needed, they were happy to help. We couldn't have asked for better mentors.

Program staff needed. UNAVCO staff needed to manage the program was underestimated. We originally envisioned program staffing levels to be similar to the RESESS internship program, including a part-time internship manager, administrative assistant, and help from an education specialist for communication workshops. Once the program was implemented, the additional professional development components (skills seminar, career circles, one-on-one intern meetings) required hiring of additional part-time staff. Interns identified these additional program elements as being key in their experience.

Key outcomes or other achievements

We have learned several lessons while managing the pilot program, and plan to use these lessons in future years of the Geo-Launchpad internship. One encouraging lesson is that the lack of formal quantitative background is not hampering the interns' ability to successfully conduct their work, the result of the type of projects designed by the mentoring teams (UNAVCO staff members). Another lesson learned is that while we recognize the importance of the home institution faculty mentors, we need to improve our mechanism for engaging the mentors prior to the start of the summer, as well as consider and adapt for students who may be transferring to a 4-year institution in the fall following the summer program. We found the Career Circle discussions enabled the interns to explore a variety of professions that may not have been readily apparent during their time in school.

Training and professional development

Training and professional development was implemented with three distinct groups: interns, UNAVCO staff, and faculty mentors.

Intern professional development. A significant element of the Geo-Launchpad program was structured professional development for interns.

Formal program application. Interns applied to the program through the UNAVCO online application portal, the same portal used for all hiring at the UNAVCO. This provided students with experience in submitting formal work applications. Program staff followed up with interns on their experience.

Communications skills. A weekly 2-hour communications workshop helped students develop and refine mechanisms for communicating their work to non-technical audiences. Tips on effective networking were also discussed. This workshop was joint with the RESESS interns, allowing opportunity for near-peer interactions.

Career Circles. Informal lunchtime discussions with professionals working in various sectors of geosciences provided students with an opportunity to practice their communication and networking skills.

Brown-bag lunch discussions. Informal lunchtime discussions with Geo-Launchpad program staff focused on developing professional skills including informational interviewing, resume development, and elevator speeches.

Technical skills. Interns learned technical skills while working with UNAVCO staff on their summer projects. Skills included GPS basics, types of GPS

instruments and campaigns, Terrestrial Laser Scanning (TLS) basics and uses of TLS and range error and accuracy determination.

Graduate school round table. Joint with RESESS interns, Geo-Launchpad interns met with geology graduate students from the University of Colorado for a question/answer session on all things graduate school.

Faculty mentors. Four faculty members participated in the Geo-Launchpad program. They were brought to UNAVCO Headquarters in Boulder for 2 days of training and participating in the intern final summer presentations. Faculty members were given training on best practices in mentoring including differences in mentoring versus advising, mentoring students from minority populations, and different types mentoring strategies.

UNAVCO staff. Four UNAVCO technical staff worked daily with the Geo-Launchpad interns. Prior to the start of the summer, these staff and their two managers met with program staff. During these meetings technical staff were provided with guidance on how to develop a project appropriate for the interns, tips on how to manage undergraduate interns, and general tips on managing others' work. The four staff involved in the program are field engineers and do not manage people as a part of their normal duties. This was a opportunity for them to develop and practice managerial skills.

Dissemination of Results

Results of this work and information about the Geo-Launchpad program are available on a subset of pages on the UNAVCO website. The faculty mentor workshop at the end of the summer program was a way to share preliminary results with individuals outside Colorado. A UNAVCO staff member participated in an NSF-sponsored workshop focused on broadening participation in the geosciences in two-year colleges and MSI (Minority Serving Institutions). During this workshop, she shared the experiences and lessons of the Geo-Launchpad program. The Geo-Launchpad program was identified as a model program others should consider replicating or drawing programmatic elements from.

Plans for next Reporting Period

During the next reporting period, we will finish out the faculty-mentoring portion of the program. Interns and mentors will meet during fall 2015 and submit a report to UNAVCO. We will create additional pages on our website with resources for faculty mentors, focused on 'How to be a mentor'. The Geo-Launchpad program will continue next summer, with a slightly changed focus to Colorado community college students. We will modify the program accordingly, incorporating implementation recommendations from evaluation results from summer 2015.

Products

Conference Papers and Presentations

Morris, A.R., and D.J. Charlevoix, Geoscience Workforce Development Activities at UNAVCO, SERC Earth Educator's Rendezvous, Boulder, Colorado, July, 2015.

Other Publications:

Downs, D., J. Whiteaker, M. Okal, K. Williams, and C. Crosby, Range Precision and Accuracy of Terrestrial Laser Scanners, Poster Session, UCAR Center Green, Boulder, Colorado, July 30, 2015

Ho-Liu, A., N. Ingraham, S. Niebuhr, A. Zaino, and J. Pettit, Applications of UNAVCO GPS Equipment for Polar Research Support, Poster Session, UCAR Center Green, Boulder, Colorado, July 30, 2015

Ingraham, N., A. Ho-Liu, S. Niebuhr, A. Zaino, and J. Pettit, Applications of UNAVCO GPS Equipment for Polar Research Support, UNAVCO colloquium, Boulder, Colorado. July 29, 2015

Whiteaker, J., D. Downs, M. Okal, K. Williams, and C. Crosby, Range Precision and Accuracy of Terrestrial Laser Scanners, UNAVCO colloquium, Boulder, Colorado. July 29, 2015

Websites

Geo-Launchpad website: <http://www.unavco.org/education/student-opportunities/geo-launchpad/geo-launchpad.html>

The address above is the landing page for the programmatic web site/pages for Geo-Launchpad. The web content is housed within the primary UNAVCO website, within the Education | Student Opportunities section. Content includes information about the program, how to apply to the program, an FAQ, faculty mentoring information, a link to the faculty application form, and a calendar of events.

Impacts

The Geo-Launchpad Internship is a summer internship program dedicated to exposing early academic career students to research and increasing diversity in the geosciences. This was a pilot program engaging four interns and four faculty members.

Impact on development of geosciences discipline

The geosciences are noted to be a STEM (science, technology, engineering, mathematics) discipline with significantly low participation of persons from minority and underrepresented groups. This pilot program has demonstrated an effective model to engage two-year colleges and early academic career students in programs that will provide exposure to both academic pathways in geoscience and career options in geoscience and related fields.

Impact on other disciplines

The PIs intend to submit to scholarly journals a summary of the pilot program results. This activity (providing internships to students) had a broad array of journals that are consulted by multiple disciplines. Through such publications, other internship providers and universities may learn about Geo-Launchpad practices and outcomes and incorporate elements into their own disciplinary internship programs.

Development of human resources

The Geo-Launchpad program provided UNAVCO technical staff opportunity to develop people management skills, as well as skills aligned with time management, project management, and interpersonal communications. Geo-Launchpad Interns were provided opportunity to develop skills helpful in working in a collaborative environment. This is

notable in that collaboration in the workplace has a different orientation than academic or classroom collaboration. Students noted this difference and sought assistance in improving their collaboration skills.

Impact on institutional resources

UNAVCO runs multiple internship programs. In order to efficiently manage these programs, UNAVCO Business Affairs has fully integrated the internship-related support activities into their work flow. The internship was also designed to provide additional intern capacity to programs within the organization. This has been favorably received by all Program Directors in UNAVCO.

Impact on society beyond science and technology

This program provides technical training of future geoscience workforce and also acts as an introduction of early academic career students to the diversity of careers in the geosciences. Faculty at community colleges and universities are now more aware of workforce employment options for students.

Changes

Actual or Anticipated problems or delays and actions or plans to resolve them

We experienced very few unanticipated challenges. The capacity of staff to manage multiple internship programs (RESESS, Geo-Launchpad, and USIP) was overestimated. As a result, it was necessary to shift staff funding in order to include an additional UNAVCO staff member as a part-time program assistant. Another challenge was the engagement of interns' home institution faculty mentors during the summer. The intent was to have interns and faculty members communicate on a regular basis throughout the summer. This was difficult due to faculty schedules and the work schedule of the interns.