

# Annual Report

**Collaborative Research: GP-EXTRA: Geo-Launchpad: Preparing Colorado Community College Students for Geoscience-Focused Careers**

**Grant Period:** December 3, 2015 – December 2, 2018

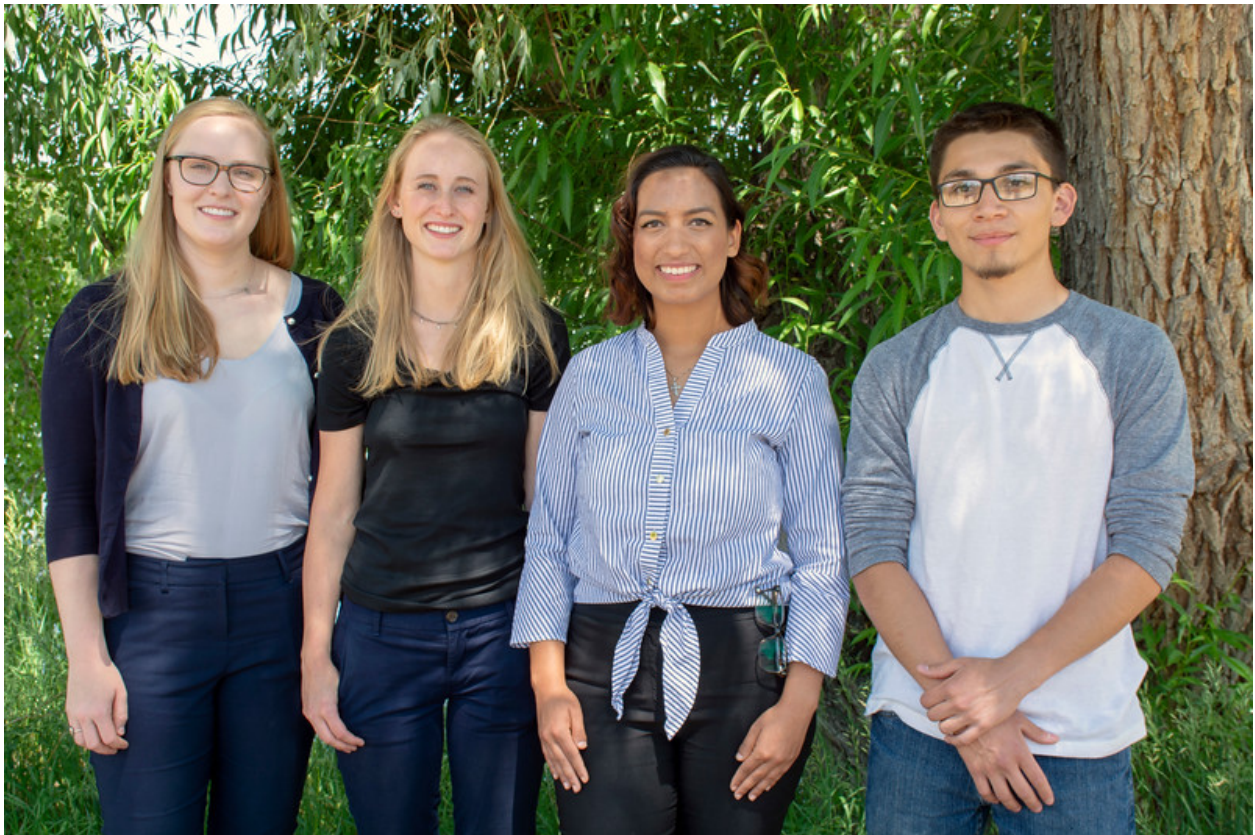
**Reporting Period:** December 3, 2017 – December 2, 2018

**UNAVCO Investigators:** Donna J. Charlevoix and Aisha R. Morris

**Front Range Community College Investigators:** Patrick L. Shabram and Shashi Unnithan

**Award IDs:** 1540588 (FRCC), 1540524 (UNAVCO)

**Program-track:** IUSE-Engaged Student Learning: Exploration



# Accomplishments

## What are the major goals of the project?

The IUSE program: The Geo-Launchpad Program (GLP) is a collaborative effort between Front Range Community College (FRCC) and UNAVCO, a non-profit, university-governed consortium that facilitates geoscience research and education, to provide community college students in Colorado with experiential learning opportunities in geoscience through summer internship programs that impart technical knowledge and development of students' soft skills for advancement along career pathways in the geosciences. The project also builds curriculum and new instruction materials to support these and other internship/employment opportunities, career exploration through seminars and workshops, and a mentorship program. The project has three overall goals:

*Goal 1: Build students' interest and capacity to engage in geoscience-focused STEM (science, technology, engineering, mathematics) career pathways.*

*Goal 2: Professional development of community college STEM faculty as mentors to students in geoscience focused careers.*

*Goal 3: Increase the number of students from community colleges that transition to geoscience-focused careers.*

## What was accomplished under these goals?

### Major Activities

Two tracks of primary activity took place. The first of these activities was to provide academic pathways for students to learn, engage, and pursue further academic, research, and career opportunities in STEM related fields focusing on geoscience. The second of these activities was a summer internship for students.

### *Academic Pathways*

The primary academic activity of the Geo-Launchpad program is the development of curriculum. Other activities included on-campus seminars and professional development activities for faculty at two-year colleges.

### Curriculum Development

A course, "GEO 210 Careers/Research in the Geosciences" is now offered as a one credit course at the Larimer Campus of Front Range Community College.

The course includes presentations of internship opportunities (including but not limited to Geo-Launchpad), student investigation of current research, information on transfer to four-year colleges, expectation of courses required for admission to four-year colleges and future careers, a field trip to UNAVCO, and guest speakers. Guest speakers in 2018 included a representative from the NSF-funded Research Experience for Community College Students program (RECCS) at the Cooperative Institute for Research in the Environmental

Sciences (CIRES), a retired hydrologist from U.S. Geological Survey (USGS), and a former intern with the Geo-Launchpad program.

“GEO 210 Careers/Research in Geosciences” was offered in spring each of the past three years at Front Range Community College’s Larimer Campus and is currently on the Spring 2019 schedule.

### Seminar

Seminars focused on local summer internships were presented at the three main Front Range Community College campuses (Fort Collins Larimer Campus, Boulder County Campus, Westminster Campus). These seminars were led by UNAVCO personnel and Front Range Community College faculty. Both students and faculty were welcome to attend. Seminars included information about UNAVCO, information on the Geo-Launchpad internship and other internship programs at UNAVCO, recommended coursework for internships like the Geo-Launchpad internship, and a question and answer session.

### Professional Development for Faculty

Faculty were offered opportunities to learn of internships, careers, and recent research in the geosciences for the purpose of passing this knowledge on to students. Faculty were invited to the above noted seminars. Further, earth science faculty and college administration were invited to attend an end-of-internship poster symposium, which included Geo-Launchpad interns along with over 60 students from multiple Research Experiences for Undergraduates (REU) opportunities in the Boulder, Colorado area.

### ***Internship***

The primary activity for the Geo-Launchpad program is a summer internship for Colorado community college students. The focus of the internship is to develop research-ready skills, rather than conducting independent scientific research. Four interns spent eight weeks of the summer working at the United States Geological Survey (USGS) in Lakewood, Colorado and participating in extensive professional development at the UNAVCO headquarters in Boulder. Their experience included the following major activities:

### Team-Building Workshop

Geo-Launchpad interns participated in a day of professionally facilitated activities that emphasized team building and communication. Through the various activities, interns were able to explore each other’s’ skill sets, personalities, and work ethics by collaborating as a team to problem-solve and complete exercises. Interns reported that participating in this workshop helped to 'break the ice' and gain familiarity with teammates early on in the program. Sixteen UNAVCO interns participated in this workshop; the other interns were more academically advanced (upper-level undergraduate and graduate students) in RESESS (Research Experiences in Solid Earth Science for Students) and USIP (UNAVCO Student Internship Program). This workshop provided an initial bonding experience that resulted in near-peer mentoring throughout the summer.

### Research Support Project

Interns worked collaboratively in pairs on a research support project under the direct supervision of USGS technical staff. Students were provided office space and any required

computing resources and supplies within the facility where they worked. Technical training was provided throughout the experience.

### Field Trips

Interns participated in two geoscience-focused field trips. Geo-Launchpad interns visited Rocky Mountain National Park (RMNP) along with upper-division undergraduate interns, graduate interns, and postgraduate interns involved in other internship programs at UNAVCO. The field trip focused on the geological history of the Rocky Mountains and included a tour from a RMNP ranger. The interns also joined students from the RESESS internship program for an overnight field trip to the University of Colorado Mountain Research Station, led by CU faculty and graduate students.

### Communications Seminar

Interns participated in weekly seminars at UNAVCO for formal and informal communications as a student and a scientist. These seminars were collaborative with RESESS and USIP interns and allowed for opportunities for near-peer mentoring.

### Geoscience Career Circles

Guest speakers from various geo-workforce sectors joined the interns over lunch once a week at UNAVCO for an informal discussion about their jobs and career paths. Sectors included industry, research, academia, government, non-profit, and consulting. Students from RESESS and USIP also participated, which led to a broad scope of discussion during the question and answer period.

### Skills Workshop

Interns met weekly at UNAVCO for a skills workshop that provided professional development on topics including digital file organization, time management, technical writing, conflict resolution, and basics of select software packages including Google Earth and Adobe Illustrator.

### Individual Weekly Check-ins

Interns met one-on-one with a program staff member each week during the summer to report their progress, discuss goals, and address any concerns. Because the interns completed their projects at the USGS facility, the weekly check-ins allowed a different opportunity for program staff and interns to remain connected.

### Communication with Faculty Mentors

Interns participated in the program along with a faculty member from their home institution who served as a mentor before, during and after the summer program. Interns were encouraged to communicate with their faculty mentors throughout the summer, sharing work highlights and internship summaries. This allowed their faculty mentors to stay abreast of the interns' experiences. Faculty mentors visited UNAVCO at the end of the summer for a lunch discussion and attended the interns' poster symposium, described below. In the fall following their internship, students meet with their faculty mentors to discuss career paths, opportunities on campus, and how to stay connected with the scientific community.

### Project Dissemination

Students presented their work in a poster symposium at the end of the summer. Interns from similar geoscience summer programs also participated, totaling over 60 posters presented. Members of the local scientific community were invited to the symposium and interacted with the interns. Students also presented posters at a national conference in the fall following the internships.

### ***Faculty Mentorship***

The Geo-Launchpad Program includes faculty mentorship to develop a supportive relationship with a faculty member from the intern's home institution. The goal is for the student to have an individual to follow up with after the internship program concludes and to help guide them as they continue on a path towards a career in science, technology, or engineering. All interns were required to apply to the internship with a faculty mentor. Faculty mentors were asked to:

- write a letter of recommendation for the student as part of the application process,
- regularly communicate with the intern about their work/research throughout the summer internship,
- travel to UNAVCO in Boulder on August 2<sup>nd</sup> to participate in a workshop on mentoring students and attend the student poster symposium, and
- conduct a minimum of one formal meeting with the student in the Fall 2018 semester to discuss career paths, opportunities on campus, how to stay connected to the scientific community, and any other advice that will help the student in pursuit of their academic and professional goals.

Students were required to submit a summary of the fall meeting with their mentor. Faculty were encouraged to set up additional meetings with the student to maintain a mentoring relationship. Faculty were compensated for their time with a modest honorarium after the conclusion of the fall meeting and submission of the student summary.

### ***National Conference***

Interns presented posters at the 2018 Annual Meeting of the Geological Society of American. This meeting is attended by over 4,000 geoscience professionals presenting scientific research and education-focused geoscience projects, and includes an exhibition hall, student mentoring center, and varied professional development and networking opportunities. This experience was the first national professional science conference for all four students. Interns presented their summer work in a poster session where they interacted directly with geoscience professionals and faculty from around the world, describing both their work at USGS and the overall internship experience. In addition to presenting posters, interns were required to spend time at the UNAVCO trade booth to share their summer experience with visitors to the booth.

## Specific Objectives

Data were collected by an external evaluator using both formative and summative elements utilizing mixed-methods measures including pre-post intern surveys, student surveys and surveys of scientist mentors at USGS. Student evaluations of the special topics course were also collected from students who participated in this course.

Four students participated in the special topics course (GEO 210) in the Spring 2018 semester. All four completed the course. Pre and post surveys were conducted with students in the course. All four students also completed feedback forms (standard to the college). All students specified in their response to the open-ended question on the post survey “How did this course influence your career or educational plans?” that the course helped them develop more knowledge about geoscience careers and the academic preparation they needed to enter them. Students’ only criticism about the course was that they would like for the course to be longer and go into even more depth about careers and what geoscience careers will actually be like.

The internship also proved to be highly successful. The four interns selected were highly enthusiastic, as were UNAVCO and USGS staff working with the interns and three faculty mentors. 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 strictly a research internship, items were adapted to better fit the technical work and fieldwork of the Geo-Launchpad internship. The survey gains scales items are rated on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree). 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 internships on students’ educational and career aspirations.

(Referenced figures and quotes are from attached External Evaluation Report.)

### Career knowledge and preparation

- Students from GEO 210 displayed the most growth in career knowledge (survey mean on career knowledge scale rose from 3.67 to 4.58 on a 5-point scale) (Figure 5: Student Gains, GEO 210).
- All GEO 210 students reported that their knowledge about geoscience career resources increased substantially (e.g., survey mean increased from 3.25 to 4.5 on a 5-point scale) (Figure 6: Career Knowledge, GEO 210, Item means).
- All GEO 210 students reported an increase in knowledge about academic preparation for a geoscience career and geoscience internship opportunities (e.g. survey mean increased from 3.75 to 4.75 on a 5-point scale) (Figure 6: Career Knowledge, GEO 210, Item means).

- Students and interns gained awareness about the variety of navigation techniques through a geoscience career including non-linear trajectories.
- Interns gained career knowledge about career paths in the geosciences and gained resources for navigating their own educational and career pathways (e.g. survey mean increased from 3.08 to 4.25 on a 5-point scale) (Figure 1. Skill and Knowledge Gains, GLP interns).
- No interns entered the internship with an understanding of the actual work that geoscientists do, yet 100% had this understanding at the end of the internship.

#### Technical and research skills gains

- Because projects did not emphasize instrumentation as much as projects in previous years, interns did not show the same amount of growth in this area compared to prior years (e.g. survey mean increased from a 2.75 to 2.85 on a 5-point scale) (Figure 1. Skill and Knowledge Gains, GLP interns).
- Interns gained technical expertise in areas not measured in the survey, such as computer science and programming.

#### Scientific communication skills

- Prior to the GEO 210 course, 50% of students knew how to develop a resume for a science-related internship or job; 100% could do so at the end of the course.
- Students from GEO 210 made strong gains in scientific communication skills including writing scientific reports (survey mean rose from 3 to 4.25 on a 5-point scale) (Figure 8: GEO 210, Scientific Community Skills, Item means).
- Interns' knowledge of how to prepare a scientific poster increased markedly (survey mean rose from 2.5 to 4.5 on a 5-point scale) (Figure 4: Scientific Communications Gains, GLP Interns).

A discussion of specific objectives follows.

#### *Goal 1: Build students' interest and capacity to engage in geoscience-focused STEM career pathways*

*Objective 1.1: Increase student awareness of academic and career opportunities in geoscience-related fields via a website and electronic media, workshops/seminars, webinars and annual mini-symposia at UNAVCO.*

*Objective 1.2: Increase students' knowledge and skills in geoscience fundamentals, methods, and techniques to prepare for internship experience through workshops, symposia, and a special topics course in geoscience.*

Seminars were conducted at all three campuses of Front Range Community College. Several students participating in these seminars applied for the UNAVCO internship and/or enrolled in the special topics course. Of the 11 fully completed applications received by UNAVCO for the internship, the majority were from Front Range Community College,

suggesting that the seminars may have played an influence in students' applying to the Geo-Launchpad internship. Three of the four internship students were from Front Range Community College and one was from Arapahoe Community College. The internship was promoted by the project Principal Investigator, other faculty members at Front Range Community College, and through faculty colleagues who know about the program. UNAVCO staff contacted all full time Colorado community college faculty from departments of science, geology, and geography via email to share information about the internship program, application details, and a flyer to post in their department.

While working with students in the program and after receiving feedback from the external evaluations, the leadership of the project came to understand that students gain much from the one-on-one interaction with scientists and other professionals, interaction that we do not feel is replicable via an online program (noted in 2017 annual report). As such, a decision was made to increase intern exposure to the scientific community by encouraging students to participate in a national conference including presentation of project posters. All four students from the 2018 cohort participated in the Geological Society of American 2018 Annual Meeting in Indianapolis, Indiana.

*Goal 2: Professional development of community college STEM faculty as mentors to students in geoscience focused careers.*

*Objective 2.1: Increase faculty knowledge of existing private sector and government geo-STEM careers via workshops, networking, and symposia*

*Objective 2.2: Develop partnerships between faculty and UNAVCO staff to support students*

*Objective 2.3 Develop resources for faculty mentoring and instruction*

In the previous three years of this award, UNAVCO held a 2-day workshop for Geo-Launchpad faculty mentors focused on intentional mentoring. This year there were three faculty mentors for the four interns, two of whom mentored students in previous years. Having already participate in the intentional mentoring workshop we decided to invite all faculty who provided support for the other non-selected student applications to Boulder for the poster symposium, two faculty expressed interest. A full day meeting with five faculty members (three mentors, two non-mentors) was held immediately before the student poster symposium. This meeting focused on how we can collectively support community college students from Colorado and New Mexico in their pursuit of STEM careers. A faculty member from San Juan Community College in New Mexico participated as did one from Ft. Lewis College. Students from San Juan CC have a high transfer rate to Ft. Lewis College in Durango, Colorado. All participants agreed to continue the conversation about how best to support students and engage them in internship opportunities and geoscience and STEM career preparation.

*Goal 3: Increase the number of students from community colleges that transition to geo-focused careers.*



*Objective 3.1: Provide students with authentic and experiential opportunities in geoscience-related work through internships at UNAVCO involving its science and technology consortium members.*

A total of four interns participated in the UNAVCO internships and four students completed GEO 210. One student both took GEO 210 and was a Geo-Launchpad intern. That student, who had originally planned to pursue a degree in geoscience related field before questioning that decision, has since confirmed her desire to pursue a geoscience degree. She reported applying for the UNAVCO internship because of her participation in GEO 210. This student is now planning to attend graduate school after completing her four-year degree, and she is actively looking for summer 2019 internship opportunities.

At least one 2018 intern has already enrolled at a four-year university to pursue a degree and eventual career in environmental science. Five of the eight 2017 interns have transferred to four-year colleges and one 2017 intern participated in a highly competitive Research Experience for Undergraduates program during summer 2018. A student from the 2016 internship recently shared that he had been accepted to a graduate program at Colorado State University in watershed science.

## **Significant Results**

(Referenced figures and quotes are from attached External Evaluation Report.)

Results from student interviews, surveys and focus groups show that both the GEO 210 course and the internship provide significant information and insight to students about the steps necessary to pursue STEM and geoscience degrees and the breadth of career opportunities available in the geosciences. Of the four students participating in GEO 210, three applied for internships, with one student receiving offers to three different opportunities. A second student was a finalist for an internship, but was not ultimately selected. This student has, however, already started applying for internships for summer 2019.

Students' strongest growth over the summer internship was in their knowledge of career pathways, scientific communication, and preparations for geoscience careers (Figure 1: Skill and Knowledge Gains, GLP interns). No interns entered the internship with an understanding of the actual work geoscientists do, yet 100% had this understanding at the end of the internship.

Interns thought that one of the most valuable aspects of the GLP internship was the understand that professional life is neither linear nor pre-determined was a significant takeaway. The interns also noted the significance of the intersection of science and the federal government. Experiencing the magnitude of resources available through a government agency such as the National Science Foundation was eye opening. They also gained experience with the contemporary work environment for many professionals, for example, a piece of technology not working and how that needs to be dealt with in real time.

### Technical Skills/Instrumentation

In contrast to prior years, interns did not significantly increase in their understanding and use of technical instrumentation. Because the projects did not emphasize instrumentation as much as projects in previous years, students did not show the same amount of growth in these areas. However, through focus group discussions it became apparent that gains were made in areas of expertise not measured on the survey, such as computer science and programming. One intern entered the internship with no interest in programming and by the end of the program, was more open and receptive to pursuing a path involving computer programming or database management.

### Communication Skills

Students in the careers course saw an overall increase in communication skills. Survey means rose from 3.5 to 4.14 in this area (Figure 5: Student Gains, GEO 210). The greatest gain was seen in understanding of scientific reports (Figure 8: GEO 210, Scientific Community Skills, Item means). In addition, students felt more comfortable in their ability to critically analyze a scientific paper by the end of the course (Figure 8: GEO 210, Scientific Community Skills, Item means). Throughout the course, students gained a better understanding of scientific research and how scientists communicate their work.

Interns reported strong growth in communication skills, especially in areas involving creating and presenting a scientific poster. At the start of the program, only 25% of interns had an understanding of how to prepare a scientific poster, but 100% of interns did by at the end of the program. Interns showed less growth in areas that were not emphasized as much by the GLP program, such as reading journal articles (e.g. item means stayed steady at a 3.75) (Figure 4: Scientific Communication Gains, GLP interns).

### Organizational and Project Management Skills

Surprisingly, given the breadth and depth of their projects undertaken over the summer, interns remained steady in their perceptions of their organizational skills (Figure 1: Skill and Knowledge Gains, GLP interns). This is largely because they entered the program with exceptionally strong skills.

### Career Preparation

Interns demonstrated gains in career preparation (survey mean rose from a 3.59 to a 4.33 in Figure 1: Skill and Knowledge Gains, GLP interns) despite entering the internship feeling already prepared in some areas such as feeling prepared to study at a 4-year college and believing they can succeed in future geoscience courses. Interns made the most gains in understanding the everyday work of geoscientists and understanding the nature of professional environments. Survey means rose from a 2.5 to a 4 in this area (Figure 3: Gains in Career Preparation, GLP interns). Interns discussed specific learning gains in becoming aware of federal regulations, the organization of government agencies, and the use of software technical tools.

Students in the careers course made gains in their knowledge and preparation for a geoscience career despite entering the course with a higher level of career preparation than they did last year (survey mean rose from 3.95 to a 4.63 in Figure 5: Student Gains, GEO 210). For instance, students made great gains in their ability to develop a resume for a

science-related career or internship (survey mean rose from a 3 to a 4.5 in Figure 7: Career Preparation, GEO 210, Item means). In fact, 50% knew how to develop a resume for a science-related internship or job, yet 100% could do so at the end of the course. Students also increased their confidence that they could succeed within geoscience courses (survey mean rose from a 4 to a 4.75 in Figure 7: Career Preparation, GEO 210, Item means).

### Intellectual Gains

Interns entered the GLP internships with strong self-reported problem-solving skills and understanding of the important concepts in geoscience (survey mean rose from a 4 to a 4.1 in Figure 1: Skill and Knowledge Gains, GLP interns). Students remained steady in their ability to formulate a question that can be answered with data and in feeling prepared for research. The projects this past summer were less research-oriented than in the past. Interns were exposed to a forward-learning science that crossed disciplinary boundaries and relied on multiple data sets and analytical approaches. The use of data and its interface with technology were also prominent in the interns' exposure to science in the USGS.

### Preparation for research

Interns recognized the emphasis of work at a computer using computer science and programming during their internship. One intern noted that a mix of deskwork and interns reported a gain in appreciation for the importance of computer programming in geoscience research. Interns gained a better understanding of geoscience workplace research environments that could transfer to almost any professional or research career. Interns gained valuable skills in research presentation such as constructing and presenting a scientific poster.

### Collaboration and Networking

Interns entered the GLP internship with strong collaborative skills and remained steady in this category (Figure 1: Skill and Knowledge Gains, GLP interns). Nevertheless, interns discussed the importance of teamwork as an essential component of professional scientific practice. This year's cohort of 2018 interns presented their summer projects at the Geological Society of America Annual Conference. This was an opportunity to communicate their findings to and network with an international, professional audience.

### Mentoring

Interns and their mentors at USGS described the benefits they received from working together throughout the internship program. The interns discussed how their mentors had taken an interest in their career paths and made efforts to discuss career options with them. The mentors were able to take on projects that they did not have the resources or staff to complete.

### Influence on Career Intentions

The interns reported that the GLP internship helped them narrow their own interests and aspirations within the geosciences. Interns were able to clarify professional goals after the internship, specifically interest in graduate school. The internship gave students confidence in pursuing their interest in geoscience. They felt comforted that they had chosen the right field for themselves.

## Faculty Outcomes

The GLP internship also had a positive impact on the faculty mentors themselves, expanding their awareness of the different types of projects undertaken by the geoscience workforce (specifically UNAVCO and USGS) and keeping them apprised of current work in the field. Several faculty members participated in a workshop to explore possible future iterations of Geo-Launchpad like activities, including a faculty member at a community college from outside Colorado (New Mexico). At least two faculty members have noted their intent to explore similar programs at their respective institutions.

## **Key outcome and other achievements**

Perhaps the biggest achievement of the seminars, special topics course, and internships, is building confidence in the student that this type of work is indeed something they can do.

Students and USGS staff were very positive about the format of the GLP internship and its benefits for students. Students and faculty expressed of positive feedback about the implementation of the GLP internship. Some of the highlights from interviews and survey written responses were:

- Interns
  - “One thing I liked is nobody had a completely straight path. It’s not like they went to school, they graduate, they got a job. They had multiple jobs that might not have fit them as well but it led to their next job and then up until they got their career and they were happy... You have lots of different jobs and that was nice because none of them really knew what they were doing, which is refreshing to hear because you think everybody’s got it together, but they don’t.”
  - “We got to explore through, just our own research, looking at federal projections. We kind of dove a little bit into state protections. We got a lot of knowledge on that. We also got knowledge on program like Python, QGIS, which I had never had an experience with before... let alone knowing what it is, so it was super helpful.”
  - “I really liked the career workshops and the skills seminars at UNAVCO because they just taught us a lot of skills from elevator talks, and interviews, and CVs, cover letters, resume building, all of that. I think that was something I would definitely take away from this internship.”
  - “I didn’t really think programming was for me before because I just didn’t think it was... I thought you had to be super, super smart to do it and just didn’t think I could do it. After this internship, it kind of taught me that anyone could do it; you just have to learn it, practice it. It’s definitely created a new path for me to want to continue my education with programming and just kind of showed me that I can do computer stuff and it’s not as daunting and scary as it seems, in my own head at least.”

- “I would have struggled with it personally if I wouldn’t have had my partner. One of the really good things was having a partner. I liked that... We could struggle through together and then learn together.”
- “I think that for me it reaffirmed that geosciences is the field I want to go in to.”
- USGS staff mentors
  - “For myself, I haven’t supervised many people, in recent years, anyways. So it was a good opportunity to interact [on how to take a] project forward, and learn a lot of things along the way. That was something that I enjoyed a lot and got a lot out of.”
  - “UNAVCO’s being well structured made this a lot more successful than some programs that may not quite have things set up quite as well. It made it a lot easier in the end, and their staff was always there to answer questions, and things like that as well.”

## **What opportunities for training and professional development has the project provided?**

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

### Student professional development

Students in the special topics course met and interacted with professionals from a number of related fields. Further, students were required to prepare a resume, distinguish between a resume and a curriculum vita, and analyze technical papers.

### Intern professional development

A significant element of the Geo-Launchpad program was structured professional development for interns. A weekly skills workshop was implemented to provide interns basic training in applications such as Google Earth and Adobe Illustrator. Soft skills such as time management, digital organization, technical writing, and conflict resolution were also addressed. The weekly communication seminar was offered jointly with the RESSESS and USIP internship programs, facilitating near-peer mentoring between the upper division undergraduates conducting independent research projects (RESSESS and USIP) and the two-year college students conducting research support projects (Geo-Launchpad). The joint seminar also enabled staffing efficiencies as content was delivered to both internship programs at one time. The 2018 intern cohort attended and presented posters of their summer project at the Geological Society of America Annual Meeting 2018 in Indianapolis, Indiana.

### Faculty and faculty mentors

This year, five community college faculty members participated in the Geo-Launchpad program. Two had received previous mentorship training, with one faculty mentor participating for the first time in the program. Two served as advisors for consideration of future programs like Geo-Launchpad.

### USGS staff mentors

Program staff provided professional development sessions to the staff mentors from the USGS. A program orientation conducted at USGS provided an overview and information for staff on best practices for working with community college students (entry-level), how to design projects, and recommendations for setting expectations for the summer. This information was included in a *mentor packet* that was provided to each staff mentor. USGS staff received additional guidance on mentoring students during a meeting in Boulder at UNAVCO where they participated in the selection of student interns.

### **How have the results been disseminated to communities of interest?**

The results of student internships were shared with faculty mentors at the end of the internship, as were posters presented at an annual Student Poster Symposium in Boulder, Colorado. Results of the work of interns is available on the UNAVCO website. Presentations about the program also were made at the American Association of Geographers Annual Meeting in New Orleans, Louisiana along with student poster presentations of their summer projects at the Geological Society of America Annual meeting in Indianapolis.

### **What do you plan to do during the next reporting period to accomplish the goals?**

The second and third year of the program introduced the internships to community college students outside Front Range Community College. The next year will focus on expanding participation to better gauge the net impacts of the program and introducing more faculty to the program. With the realization that many applicants have faculty mentors already familiar with the program and on campus seminar programs seem to thrive when faculty members familiar with the Geo-Launchpad promote the program with the students, the goal will be to bring other faculty members into the mix. That includes outreach to other faculty in and around Colorado, and expanding the understanding of the GEO 210 Careers/Research course. The fourth extension year will also focus on preparing the 2019 interns to present their summer internship findings at a national and/or regional conference.

The programmatic elements of the 2019 internship will be implemented in a similar way to 2018, with a few modifications based on the positive evaluation data and post-summer program team discussions. Significant efforts will be made to inform community college faculty across the state of Colorado about the internship program including again contacting individuals from geology, geography, and physics departments. Within UNAVCO, the internship will be expanded to eleven weeks to allow for greater training and implementation of the internship program. The number of interns in summer 2019 will be increased from 4 to up to 6, with all interns likely working at the USGS and participating in professional development at UNAVCO in Boulder. Interns selected in previous years have included students attending a two-year college to obtain certificates, particularly in GIS. The design of the program is structured to assist students who have not yet obtained bachelor's degrees, and in order to ensure students benefit from the programming, next summer we will target community college students who demonstrate an intention to transfer to a four-year university to continue their studies.

## Products

### Conference Papers and Presentations

Housel, Jaqueline (Presenter), Shabram, Patrick L (Discussant), Dechano, Lisa, Hess, Darrel, Johnson, Melvin, Patton, Jessica, Lannon, Heidi, and Porter-Morgan, Holly, "The Role of Two-Year Colleges in Recruiting Future Geographers," panel discussion, American Association of Geographers Annual Meeting, April 2018.

Porter-Morgan, Holly (Discussant), Bueneman, Michaela, Hoffman-Hall, Amanda, Labosier, Christopher, Maeer, Jessica Patton, and Shabram, Patrick L., "Teaching and Advising about Careers in Geography," panel member, American Association of Geography Annual Meeting, April 2018.

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Pawloski, Jamie and Shabram, Patrick L., "Building Pathways to STEM Careers through Community Colleges," Successful Lives...Strong Futures, Front Range Community College, September 2018.

Cuevas, Santiago, Gallagher, Katie, Stevens, Jenny, and Van Cleave, Keith, "The Modern Library: Digitizing Historic Photographs and Field Records of the United States Geological Survey," Geological Society of America Annual Meeting, November 2018

Donovan, Grace C., Hurtado, Alexandra M., and Wieferich, Daniel J., "Using National Hydrography Linked Data to Better Understand Wild and Scenic River Protections," Geological Society of America Annual Meeting, November 2018

### Other Products

"Launch Your Career with a Paid Internship in Geoscience," flyer for all Colorado community college students (2019).

"Launch Your Career with a Paid Internship in Geoscience," for Front Range Community College students (2019).

"Be a Geo-Launchpad Mentor," for all faculty interested in becoming a mentor (2019).

**Geo-Launchpad website:** <https://www.unavco.org/education/internships-opportunities/geo-launchpad/geo-launchpad.html>

## **Impacts**

### **What is the impact on the development of the principal discipline(s) of the project?**

The geosciences, as a STEM field, are noted for low participation by underrepresented groups. Geo-Launchpad has proven effective in engaging community college students (which is commonly the first postsecondary school for many underrepresented groups). Faculty at Front Range Community College, Arapahoe Community College, Pikes Peak Community College, San Juan College, and Fort Lewis College are currently collaborating on possible future projects to build student successful transfer into four-year colleges.

According to the external evaluation, USGS mentors also noted that the internship was productive for their own scientific team members. The teams themselves collaborated closely because of the interns and, thus, laid the groundwork for future projects. That students came to the agency with “fresh eyes” meant that seasoned employees needed to see their roles in a new way. The internship program allowed USGS mentors and their teams to re-engage with their work and peers. Mentors at U.S.G.S. reported interns taking on projects that may otherwise have not been accomplished due to lack of human resources.

### **What is the impact on other disciplines?**

Students participating in the summer internship learn about working in the field of geoscience through their experience with computer programming and database management. Students develop soft writing skills as demonstrated by drafting CVs, resumes, and cover letters.

### **What is the impact on the development of human resources?**

The Geo-Launchpad program provided USGS technical staff the opportunity to develop people management skills including time management, project management, and interpersonal skills. Interns were provided opportunity to develop skills helpful to working in a collaborative environment. Faculty at Front Range Community College and Arapahoe Community College have developed mentoring skills.

### **What is the impact on physical resources that form infrastructure?**

Nothing to report.

### **What is the impact on institutional resources that form infrastructure?**

Front Range Community College personnel have gained valuable experience on working with collaborative faculty led grants. Some of the departments touched by unique requests created by the Geo-Launchpad grant include Human Resources, Academic deans, and Fiscal. FRCC has made improvements to its processes to accommodate future projects.

Within UNAVCO Geo-Launchpad is executed by the Education and Community Engagement program with support from the Business Affairs (BA) program. The processes within the BA program have been updated and adapted to accommodate the internship program. Updated processes include the on-boarding of interns, method of payment for work, travel



paperwork for interns, procurement processes for internship materials, and IT support services tailored for students.

**What is the impact on information resources that form infrastructure?**

Nothing to report.

**What is the impact on technology transfer?**

Nothing to report.

**What is the impact on society beyond science and technology?**

The program has provided formal education of careers and research in the geosciences, has provided technical training of the future geoscience workforce, has taught valuable professional skills inside and outside of science, and has engaged students to seek future education. Faculty and students at both two-year and four-year colleges are now more aware of geoscience career opportunities open to students.



# EXTERNAL EVALUATION OF THE GEO-LAUNCHPAD INTERNSHIP PROGRAM, FRCC AND UNAVCO, 2018



Heather Thiry, Ph.D. & Heidi Loshbaugh, Ph.D.  
GOLDEN EVALUATION & POLICY RESEARCH

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## Executive Summary

Women and some minority groups are persistently underrepresented in geoscience. The Geo-Launchpad (GLP) summer internship program seeks to broaden participation in geoscience by engaging community college students in immersive, technical experiences while also providing mentorship, professional development and career guidance. The external evaluation of the GLP program used mixed-methods measures, including pre-post surveys and interviews to assess the impact of the program on students' aspirations, knowledge, and skills. In addition to the GLP internship, a geoscience careers course (GEO 210) is now offered at Front Range Community College in spring. The GEO 210 course was piloted in 2017 and was offered as an ongoing Geology course at Front Range Community College in spring, 2018.

Key evaluation findings are:

### **GLP internship**

#### ***Demographics of interns:***

- Three of the interns were women and one was a man.
- Two interns were white/Caucasian, one was Hispanic/Latino and one was mixed race/ethnicity: Hispanic/White.
- None of the interns was the first in their family to attend college.
- All four students plan to transfer to a 4-year degree program in the geosciences.

#### **Gains in Career Knowledge**

- Interns reported the most gains in knowledge of career options and career resources in geoscience
- 50% of incoming interns were aware of career resources in geoscience (including one intern who had enrolled in the GEO 210 course), and 100% of interns were aware of these resources at the end of the summer
- Interns also made strong gains in knowledge of career options in their field (moving from “not sure” to “agree” that they are aware of various geoscience career paths)
- From the Career Circles, interns learned about the non-linear paths taken by many professional scientists
- Interns learned about federal agencies and the variety of scientific paths within the federal government

#### **Gains in Career Preparation**

- Interns second highest area of gains was in career preparation, especially understanding the professional work of scientists.
- No students entered the internship with an understanding of the everyday work that scientists do, yet 100% left the internship with this understanding.

- Interns gained a better understanding of professional work environments, including the importance of organization, planning, teamwork, and trouble-shooting in professional, scientific settings.

### **Scientific Communication Skills**

- The third largest area of growth for interns was in scientific communication skills, especially preparing a scientific poster.
- At the start of the internship, only 25% of interns understood how to prepare a scientific poster, but 100% did at the end of the summer
- Interns received substantial coaching and mentoring in preparing their scientific posters from their scientist mentors.

### ***Technical gains***

- Because of the nature of their projects, interns did not make the same gains in instrumentation skills as they did in previous years; however, they gained computer science and programming skills to a larger extent than they did in past years.

### ***Career aspirations***

- Three out of the four interns were actively considering graduate school because of the GLP internship

### **GEO 210 course**

#### ***GEO 210: Student Demographics***

- Three students were women and one was a man.
- Three identify as white; one as Hispanic/Latino.
- All plan to receive an A.S. degree.
- All four students plan to transfer to a 4-year college or university. Intended majors varied: Geology, Geography, Anthropology, and Environmental Science.

#### **Gains in Career Knowledge and Preparation from GEO 210**

- Geo 210 students made the largest gains in understanding career paths and resources. In particular, students learned about career resources in geoscience (mean rose from 3.25 to 4.5, or from “not sure” to “strongly agree”).
- Geo 210 students also made strong gains in career preparation. For instance, 50% of students knew how to create a resume for a scientific position at the beginning of the semester, yet 100% of students could do so at the end of the semester.
- Geo 210 students also gained an understanding of the skills required for a geoscience career (moving from “not sure” to “strongly agree”).

### **Gains in Scientific Communication Skills from GEO 210**

- Geo 210 students made gains in their ability to write scientific reports and understand research articles.
- 50% of Geo 210 were confident in their scientific writing abilities at the start of the semester, but 100% were confident at the end of the semester.
- Students also gained confidence in their ability to critically analyze a scientific paper.

## **Introduction**

The geosciences have persistently low participation rates of women and underrepresented minority groups. To provide equitable access to STEM careers and to meet national workforce needs, participation in the geosciences must be broadened to women and students from traditionally underrepresented minorities. Geo-Launchpad is an 8-week summer internship program for Colorado community college students that has been offered for the past three years. Some of the important goals of the Geo-Launchpad internship program are to: 1) engage students in an extended technical project, 2) introduce students to instrumentation in the geosciences, 3) provide students with an overview of geoscience careers, 4) develop students' professional networks and skills, and to 5) enhance students' mentoring relationship with a faculty member at their home institution. In addition to technical field experiences at UNAVCO and USGS, the GLP internship program offered career seminars (Career circles), communication seminars, technical seminars, and opportunities to network with working scientists and student researchers from the Research Experiences in Solid Earth Science for Students (RESESS) program, also housed at UNAVCO. In 2018, Front Range Community College offered a 1-credit course (GEO 210) focusing on geoscience internships and careers as another mechanism to boost the career knowledge and professional skills of community college students in the geosciences. The course introduced students to current research and tools in the geosciences and provided an overview of various career paths and internship opportunities in the discipline. The course was offered in spring, 2018 and has been approved by the Colorado Department of Higher Education to be delivered at community colleges in the state of Colorado.

## **Evaluation Design and Methods**

The external evaluation of the Geo-Launchpad program contains formative and summative elements. Formative evaluation is designed to provide recommendations to modify the program for future implementations, and summative evaluation is designed to assess whether the program has met its goals and milestones. The evaluation uses mixed-methods measures, including pre-post surveys and interviews.

## **Evaluation Questions**

The external evaluation was guided by the following questions:

1. Has students' interest in geoscience careers, their knowledge about career options, and their capacity to pursue these careers increased from their participation in the GLP internship?
2. Have students' technical, networking, and scientific communication skills increased from their participation in the GLP internship?



3. What are the essential program elements that contributed to desired outcomes, and which elements might be modified in the future, if needed, to improve outcomes?

## Evaluation Instruments

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 the Geo-Launchpad internship is not strictly a research experience, items were adapted to better fit the technical, scientific and field work of the Geo-Launchpad internship. The survey gains scales items are rated on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree). Survey scales include *networking/collaboration*, *intellectual gains*, *scientific communication*, *organizational skills*, *technical skills*, *career knowledge* and *career preparation*. The networking/collaboration scale was added specifically for the Geo-Launchpad internship to align with the program focus on professional networking and scientific collaboration. The survey also measures other aspects of the internship experience, including the impact of the internships on students' educational and career aspirations. The survey was further adapted for use with students in the FRCC GEO 210 course.

The survey was administered to students in the FRCC course and in the summer internship. Surveys were administered at the beginning and the end of the course and the internship. Surveys were sent to students' e-mails through SurveyMonkey. E-mail reminders were sent every four days to students who had not responded. Reminders were sent twice. All students in the course and the internship responded to the pre- and the post-survey. GLP internship students were also interviewed in a focus group format at the end of the summer program. The interview protocol addressed the scientific and professional benefits from participating in the GLP internship, mentoring, networking, and advice for future implementation.

Scientific mentors from USGS were interviewed in a focus group at the end of the summer internship to triangulate students' self-reports about their gains from the program, to learn more about the mentorship provided in the program, and to assess the impact of the program on scientific mentor's careers and professional abilities. Intern and mentor focus groups lasted for 60 minutes. Interviews were recorded and transcribed for data analysis.

## Analysis Methods

The analytic methods described in this section apply to all data collected for this report. The quantitative data were organized in a Microsoft Excel spreadsheet where descriptive statistics were computed. Frequencies and means are reported for most of the items. Groups of items were clustered into scales to assess student outcomes in a given domain. The average of the individual items that comprise each scale was computed for the scale mean. Items were rated on a 5-point Likert scale. Tests of statistical significance, such as t-tests or one-way ANOVAs, were not conducted due to the small sample of participants.

Write-in responses to open-ended survey questions and interview transcripts were entered into *NVivo* qualitative analysis software and coded using procedures developed by Spradley (1980). Each new idea raised in a written response was given a unique code name. As these same ideas were raised by later respondents, each segment was added to an existing code reflecting that idea. At times, participants' responses were brief and represented a single category, but more frequently, responses contained ideas that fit under multiple categories, and these were coded into each category separately. Codes were organized into larger, descriptive categories, or "domains." Domains were generated deductively, from the program goals, and inductively, from the data itself. The domains and codes within them reflect the major themes that manifested in the interviews.

## **Evaluation Findings**

This section reports findings from the data collected from the GLP program in 2017-18. The section first describes the demographics of student participants in the GLP internship and the GEO 210 course. Next, outcomes for GLP interns and mentors are reported. Finally, outcomes for GEO 210 students and advice for implementation are discussed.

### **Student Demographics**

#### ***Demographics of GLP interns***

Four students were summer interns at the United States Geological Survey (USGS) for the Geo Launch Pad program in 2018. Their demographic backgrounds are as follows:

- Three of the interns were women and one was a man.
- None of the interns was the first in their family to attend college.
- All four students work outside their studies, at least 15 hour a week.
- All four were full-time students.
- All four students plan to transfer to a 4-year program in the geosciences.
- Two interns were white/Caucasian, one was Hispanic/Latino and one was mixed race/ethnicity: Hispanic/White.

#### ***Demographics of students in GEO 210***

Four students enrolled in the GEO 210 course in spring of 2018. Their demographic information is as follows:

- Three students were women and one was a man.
- Three identify as white; one as Hispanic/Latino.
- All attend college full-time.
- All plan to receive an A.S. degree

- All four students plan to transfer to a 4-year college or university. Intended majors varied: Geology, Geography, Anthropology, and Environmental Science.
- Three out of the four students work outside their studies, all who work do so for at least 15 hours a week of outside employment

### **Students' motivations for participating in the internship**

All students reported that they chose the GLP internship to learn more about geoscience careers and the nature of the work in the discipline. Students also wanted to see if geoscience was the right career path for them. Two students (50%) noted that they applied to the GLP program because they were strongly encouraged by a faculty member. In one case, the student applied to and chose the GLP internship from competing internship options because of the encouragement of a faculty mentor. Thus, interest in geoscience careers coupled with faculty support and encouragement were the primary motivations for students to pursue the GLP internship. For example, one student wrote on the survey:

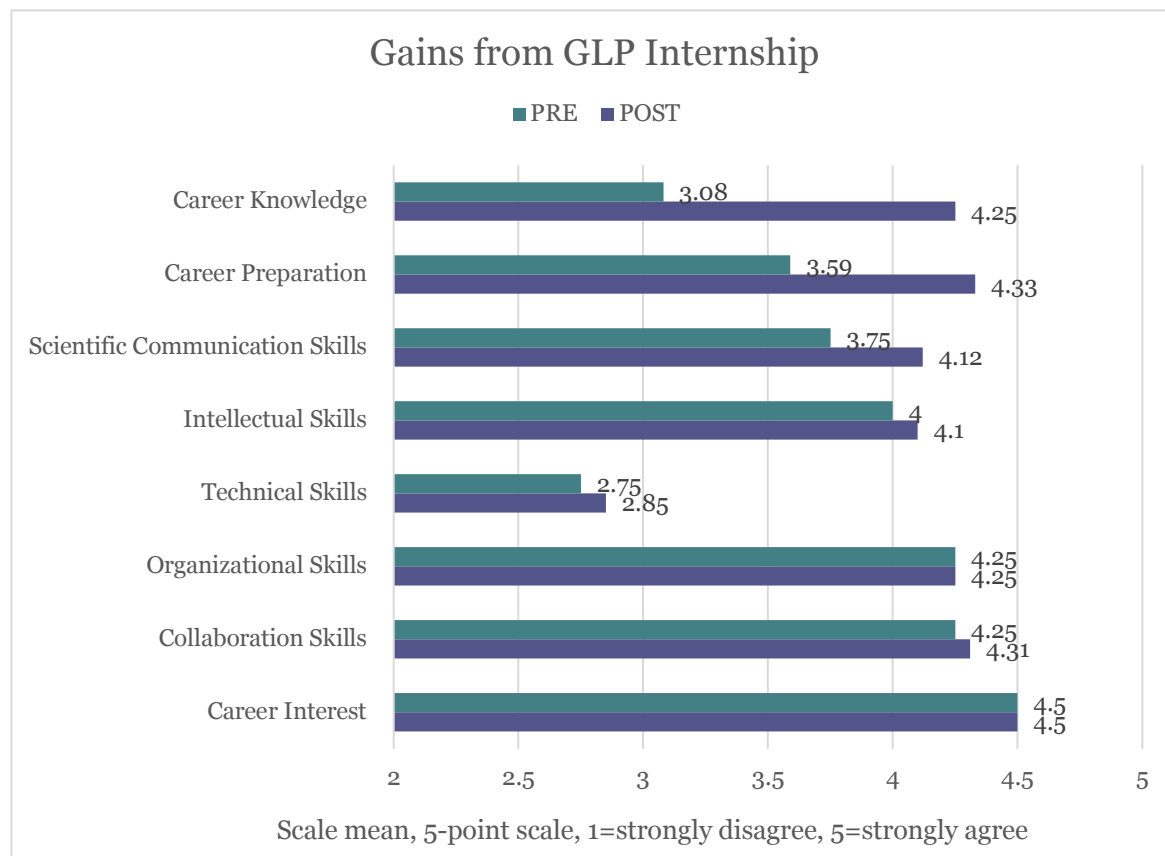
*The passion my teachers have in the geoscience fields was what motivated me to apply for the Geo-launch pad internship. The internship is a perfect opportunity to explore how passionate I am about the Geosciences and if a career in this field would be a good fit.*

## **Student Outcomes**

### **GLP Summer Internship**

Interns made especially strong learning gains in some of the areas targeted by the GLP internship, such as career knowledge of career pathways, scientific communication, and preparation for geoscience careers. Still, interns held steady in their skills in other areas, such as technical skills, as the projects that the interns worked on this past summer did not require the instrumentation expertise that past projects emphasized. Thus, interns were introduced to the variety of career paths within geoscience that do not necessarily use technical instrumentation, but rather rely on software, computer programming, and other technical skills. Students demonstrated lower growth in areas in which they entered with already strong skills, such as collaboration/teamwork, project management, self-efficacy, or interest in geoscience careers.

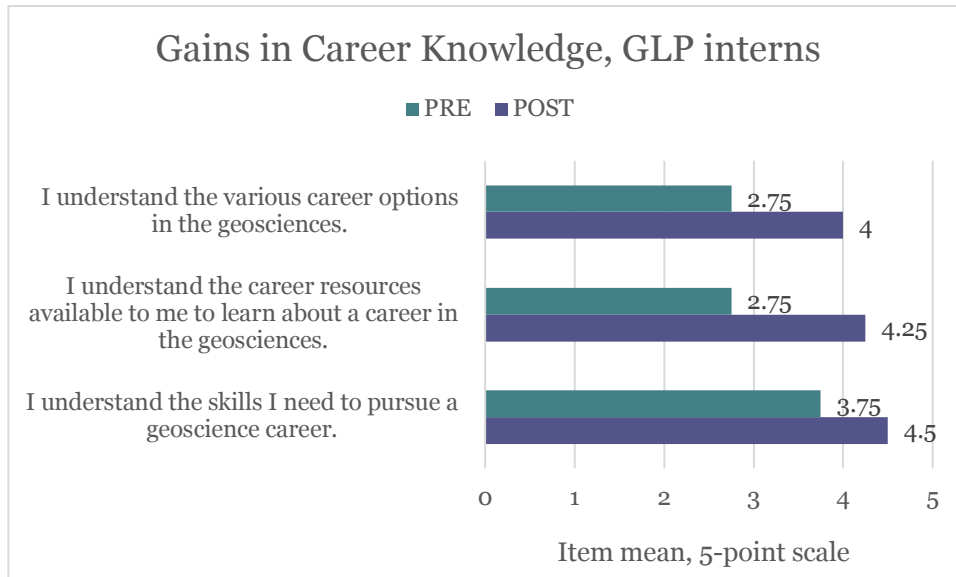
**Figure 1. Skill and Knowledge Gains, GLP interns**



### **GLP interns: Career Knowledge**

Across the board, interns learned about career paths in the geosciences and gained resources for navigating their own educational and career pathways. Interns benefited from the focus on career paths in the GLP program. Interns learned about the career options that are available in the geosciences and the educational background or credentials needed to enter those careers. Students made the most gains in their ability to access resources to learn about geoscience careers. For instance, at the beginning of the internship, only 50% of internships felt that they knew about geoscience career resources, yet 100% did at the end of the internship. Interns also gained a better understanding of the wide variety of career paths in the geosciences.

**Figure 2. Gains in Career Knowledge, GLP interns**



In interviews, GLP interns stated that they gained an overall understanding of career paths in the geosciences as well as an appreciation of the non-linear trajectory of most professional careers. They also gained understanding of the importance of a community of scientists; this is clear from their engagement with their scientific mentors, UNAVCO graduate students, and the role their faculty mentors played. The recognition that professional life is neither linear nor pre-determined was a significant takeaway--even a source of relief:

*Student #1: One thing I liked is nobody had a completely straight path. It's not like they went to school, they graduated, they got a job. They had multiple jobs that might not have fit them as well but it led to their next job and then up until they got their career and they were happy....You have a lot of different jobs and that was nice because none of them really knew what they were doing, which is refreshing to hear because you think everybody's got it together, but they don't.*

*Student #2: That was definitely, definitely helpful.*

*Student #3: Because it's daunting being an undergrad and seeing professionals. It's like, "How can I get there?"*

*Student #1: Yeah, how successful they are. It's like, "Am I ever going to get there?"*

In this way, interns learned from the Career Circles and from their other interactions with professional scientists to view their career as non-linear and to approach it as a process of discovery and to be open to opportunities.

Interns also learned about the vast array of career options within the geosciences, including professional scientist positions, academe, and federal agencies. Interns gained a better

understanding of the nature of work within these different career paths. Interns also learned about career options from their experience at USGS, and also from their interactions at UNAVCO and the other interns in programs at UNAVCO, as described in the following exchange.

*Intern #3: Yeah, so it kind of opened up the options because I had never really thought of a federal science job as ... I don't know, I just really didn't know what to think of it or what it was. It kind of gives scientists opportunity to do research but without the academia aspect of it because I really thought you could only do research if you are also teaching. I just wasn't aware that there were other options of just doing the research, like working for the government, essentially. And kind of learning those differences of working for academia, like doing research that way in your own grants, and working for the government which is more you have to publish and then you will keep your job, essentially. And so just learning how the different ones work was super helpful, kind of eye-opening to what I would want to do in the future.*

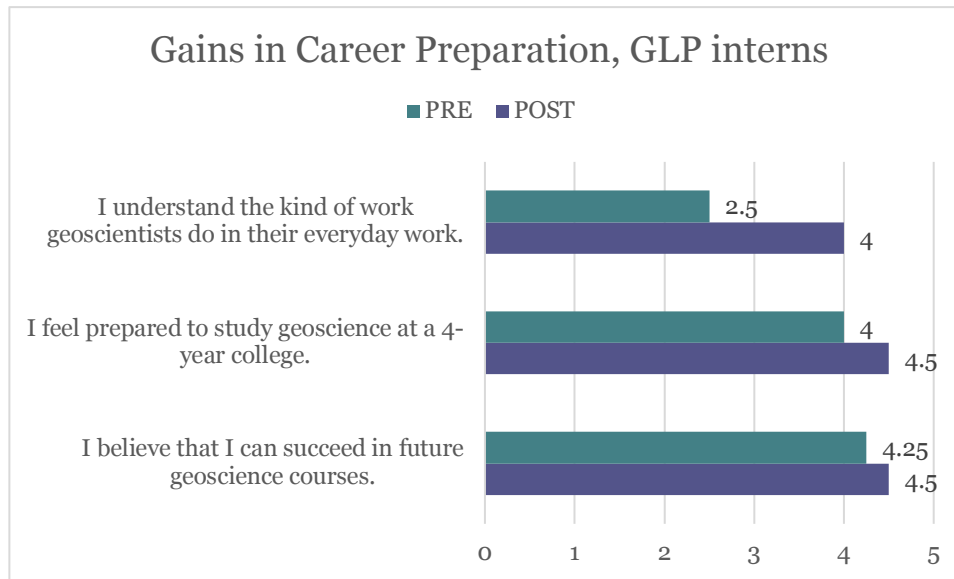
*Intern #2: To see the projects that the RESESS interns are working on and also what we're doing, there's so many different avenues and paths you can take within geoscience. I mean, I think it's really important to hone into what excites you the most. I think I've taken that away. There's a lot options. It's good to try different things to see what fits best.*

Overall, students gained a better understanding of the variety of geoscience opportunities available and the reassurance that a non-linear career path is typical.

### **GLP interns: Career Preparation**

GLP interns demonstrated strong gains in career preparation, although they entered the internship feeling already prepared in some areas. Interns already felt prepared to study geoscience at a 4-year university, but still gained some confidence in this area from the internship. Students also gained a bit of confidence that they could succeed in advanced geoscience coursework, however, they also entered the internship with a strong belief that they would be successful. Students made the most gains in understanding the everyday work of geoscientists and understanding the nature of professional environments. In fact, no students entered the internship with an understanding of the actual work that geoscientists do, yet 100% had this understanding at the end of the internship.

Figure 3. Gains in Career Preparation, GLP interns



In interviews, GLP interns discussed specific learning gains in understanding the everyday work and practice of professional scientists, such as awareness of federal regulations, the organization of government agencies, as well as learning to use technical tools, including software. Interns came to a better understanding of the scientific, as well as the non-scientific aspects of professional work in the sciences. For example, one intern stated in the interview:

*“Well, we got to explore through, just our own research, looking at federal protections. We kind of dove a little bit into state protections. We got a lot of knowledge on that. We also got knowledge on programs like Python, QGIS, which I had never had an experience with before....let alone knowing what it is, so it was super helpful.”*

One significant experience identified by interns was learning about the intersection of science and the federal government. Students were struck with the substantive role the federal government plays in geosciences and even adopted jargon they learned during the internship. Finally, for students of science, experiencing the magnitude of resources available through a government agency was eye opening; for instance, the scientific mentors were pleased with their ability to introduce interns to these resources, as noted by one of the mentors in the focus group interview.

*So I think with them being fairly new to the field and not knowing exactly what they want to go into, I feel like they, at least my students, saw a lot of different things at USGS we're doing. And I think that goes for both groups. We try to even get them into a few tours and things, to show them a few other things like the ice core lab...Students were a little blown away at what actually happens within USGS. So they got a little bit of flavor of what the agency does.*

Yet, not only were GLP students introduced to cutting edge interdisciplinary science, they also gained experience with the contemporary work environment for many professionals. For instance, interns were exposed to a real-world problem when a piece of technology did not work, despite multiple interventions over several weeks. Although unplanned as part of a summer “curriculum,” the troublesome tool proved a useful teaching experience for how professionals cope with the reality of professional and scientific tools.

*We had one particular scanner where we had swapped the computer out just before the students came and it created a lot of problems for us. So throughout the project they got to see us struggle with finding the right software, and the right drivers to get this thing going, and it was like two days before the project was over. Well, we really didn't get a chance to work with this particular machine. But, you know, that's just kind of the way it went. – Mentor*

The GLP internship also fostered a better understanding of the geosciences workplace and the variety of work environments within geoscience. For instance, the internship project this past summer emphasized work at a computer. Two interns noted that a balance of office and field work in their future career would best suit their professional satisfaction. One of the interns noted that it was “very helpful to realize” that a mix of deskwork and fieldwork would suit her temperament and interests more than a strictly office environment. And yet within the office-based projects they conducted over the summer, the interns discovered what good professionals all must do: to succeed in the “real world,” one must develop and apply flexible, creative, and persistent capacities to address real constraints in real time. Therefore, interns gained a better understanding of geoscience workplaces, as well as valuable professional skills and understandings that could transfer to almost any professional career.

Finally, the GLP internship helped students to learn and refine their professional skills, such as resume development, networking, or interviewing. Students developed their skills through the workshops offered at UNAVCO, as described in the following comment from an intern.

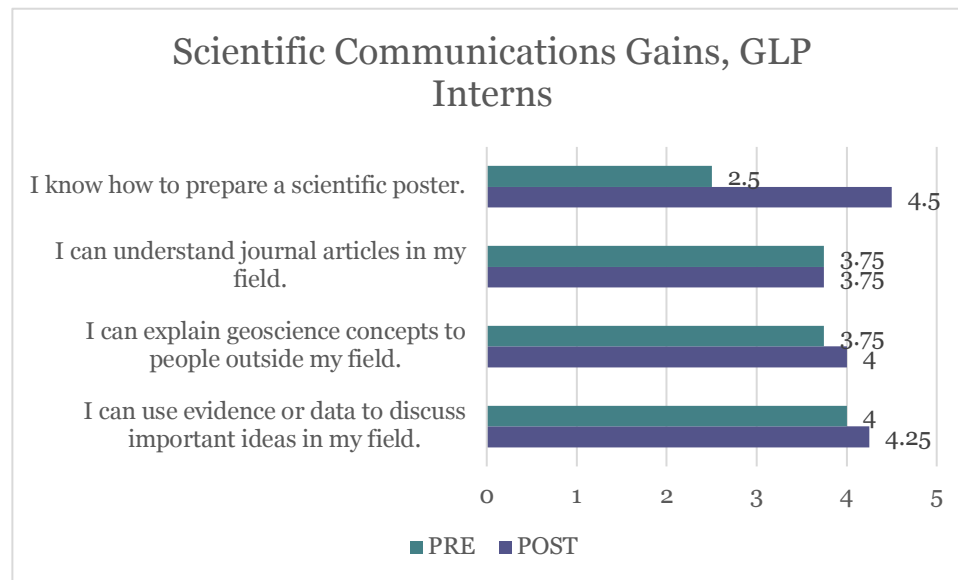
*I really liked the career workshops and the skill seminars at UNAVCO because they just taught us a lot of skills from elevator talks, and interviews, and CVs, cover letters, resume building, all of that. I think that was something that I would definitely take away from this internship.*

### **GLP interns: Communication Skills**

Interns’ third strongest gains were in the development of their scientific communication skills. Interns displayed the strongest growth in the areas specifically targeted by the Geo Launch Pad program, such as preparing a scientific poster. At the start of the program, only 25% of interns had an understanding of how to prepare a scientific poster, but 100% of interns did so at the end of the program. Students showed less growth in areas that were not emphasized as much by the GLP program, such as reading journal articles.



Figure 4. Scientific Communication Gains, GLP interns



This year's internship also includes attendance and presentation at a professional conference in the fall. The interns were very eager to attend the conference and share their work. Developing a scientific poster provided a valuable experience in communicating findings in a concise manner and the process of selecting which findings to focus on from many possibilities, as described in the following exchange.

*Intern #3: And we have a lot of data that we were working with and a lot of different applications and there were many different paths we could have gone down, but I think deciding what we wanted to do and putting it in a clear way was the biggest lesson learned, I think.*

*Intern #4: And challenge too in some ways.*

During the summer, interns received useful coaching from their mentors on the preparation and presentation of scientific posters. For instance, part of this coaching focused on striking a balance between professionalism and perfectionism, as described in the following comment from an intern.

*Yesterday, our mentor saw us working on it and he was like, "Guys, just stop looking at it because the more you look at it, the more you're going to find to change. It looks great, it's fine." That was also a lesson learned: don't look at your poster for too long because you'll find a lot of things.*

As mentors worked to nurture experiences for the interns, they themselves were reminded of the value of perspective and end goals, particularly for novices. Being able to communicate

effectively for those not deeply immersed in the work was one key takeaway. The mentors found this to be true not only in their day to day work with interns, but also in thinking about the value of scientific communication through common tools such as abstracts and posters. The scientific poster provided an opportunity for the interns to step back and communicate the big picture, while the experience of having interns, provided that same opportunity to think about and communicate the big picture for the mentors themselves.

*Mentor #1: And then the other opportunity, maybe this is common in science, but being able to tell others what you're doing is always a struggle. So having new fresh minds and faces involved in that gave me an opportunity to think about how we're explaining things. Something that I would've never really thought too much of. But, definitely its always good to have those experiences, and kind of a sounding board.*

*Mentor #2: As far as that, I would say there are times during the project when we're sort of buried in tech stuff and process stuff. But, then for the poster they're thinking about why is this important? Why is this work important? How does it fit in? Who is it serving? And some of those basic questions. It helps us to articulate that better. I think some of those things we rewrote the abstract and things like that to communicate with others in the future.*

### **GLP interns: Technical Skills/Instrumentation**

In contrast to prior years, students remained steady over the summer in their knowledge of and ability to use technical instrumentation in the geosciences. Students held steady on both of the survey items measuring their knowledge of instrumentation. Interns declined slightly in their general understanding of the variety of instrumentation used in geoscience, yet they increased slightly in their understanding of how to use major instrumentation in their discipline. Because the projects did not emphasize instrumentation as much as projects in previous years, students did not show the same amount of growth in this area. However, students gained technical expertise in areas not measured on the survey, such as computer science and programming. In this way, technical skills acquired on the job and used in support of career scientists became an important feature of the interns' experience, as described in the following quote from an intern. In this way, interns developed an appreciation for the importance of computer programming in the geosciences, and developed a commitment to learn more about it in their future education.

*I didn't really think programming was for me before because I just didn't think it was ... I thought you had to be super, super smart to do it and just didn't think I could do it. After this internship, it kind of taught me that anyone could do it; you just have to learn it, practice it. It's definitely created a new path for me to want to continue my education with programming and just kind of showed me that I can do computer stuff and it's not as daunting and scary as it seems, in my own head at least.*

Mentors also discussed this secondary area of technical, professional knowledge that interns were exposed to that fell outside of strictly “science” instrumentation. Mentors described how students gained skill in computer programming and database management, skills that are useful in the geosciences but may be transferable to other fields as well.

*Mentor #1: I think one of the things we found along the way was how useful knowing a programming language might be as part of their coursework.... It wasn't something we really planned on directly for the project, but we had an opportunity to learn some things that I can see would be very useful for us in the future. So that came out along the way.*

*Mentor #2: Yeah, we had that same thing when we first initially put forth our project. They asked what skillsets would be good, things like that. That was something that we had put on there because everything that we do seems like it touches upon computer programming or database management.*

### **GLP interns: Intellectual Gains**

Interns entered the GLP program with strong self-reported problem-solving skills and understanding of the important concepts in geoscience. Thus, interns did not demonstrate dramatic growth in scientific thinking during the internship. Interns made slight gains in problem-solving skills and in understanding the important concepts in geoscience. On the other hand, interns remained constant in their ability to formulate a question that can be answered with data and in feeling prepared for research. The projects this past summer were less research-oriented than in the past, so interns made fewer gains in their research abilities and capacities.

In interviews, interns and mentors discussed students’ burgeoning understanding of important disciplinary concepts and the intersection of geoscience with other disciplines and skill sets. As novice scientists, the GLP interns were exposed to forward-leaning science that crossed disciplinary boundaries and relied on multiple data sets and analytical approaches. In addition to working with USGS staff in Colorado, one team of interns interacted directly with field scientists across the US. These researchers revealed that data can take many different forms as federal scientists used the products of their research to construct a geospatial framework. In this case, photographs taken at different points in time served as data to allow analysis of how environments change based on use and climate, as described by a mentor in the following quote.

*During our project we were actually working with a couple of different researchers. One in the Grand Canyon and one at the water center in Idaho. So the students had a chance to interact a little bit with researchers and ask them some questions about the photos, and what they were doing with them, and how they were using them, and why they were important. So I think that was really good direct experience.*

The use of data and its interface with technology were also prominent in the interns' exposure to science in the USGS. Thus, interns gained a better understanding of the way that data and technology are used in geoscience, apart from pure research, as mentioned by a mentor in the focus group interview.

*But, I think they had an eye opener, at least [on our use of] data and focus around data, and tech side of things. We use that in everyday situations, so I try to help push them on getting engaged and learning a little bit more about some opportunities there. Actually learning some of the software and just thinking about how that might play into their future. It's everywhere, a lot of that stuff. So I think there's ... I feel like they grew a lot and in a lot of different ways, but those were just a few that really stood out. -Mentor*

### **GLP interns: Collaboration/Networking**

Similar to some other areas, interns entered the GLP internship with strong collaborative skills and a reasonable comfort level with networking with scientists. Thus, interns remained steady on almost all of the items on this survey scale. Yet, in the focus group interview, interns discussed the benefits of collaborative learning in the internship. Teamwork as an essential component of professional scientific practice was a clear takeaway for the GLP interns. Interns were appreciative of the collaboration and teamwork that they experienced on their summer projects, as described in the following exchange.

*Intern #3: I would have struggled with it personally if I wouldn't have had my partner. One of the really good things was having a partner. I liked that....We could struggle through together and then learn together.*

*Intern #4: Yeah and then we each had our own strengths and weaknesses that go well with each other....That helped a lot.*

*Intern #1: I think it was same for [my partner and me]. [Our mentor] split up some of the work so sometimes, [so we] would be doing our own thing, but then it would come back together. We, I feel like, had a good mix of both.*

*Intern #2: And a good support system for each other. If one of us was having trouble with the thing we were working on, we'd come together and work on that one thing.*

### **GLP interns: Mentoring and Project Selection**

Interns described highly positive, productive relationships with their mentors and the mentors themselves described the personal and professional benefits they received from working with summer interns. All interns discussed in the focus group interview how their mentors had

taken an interest in their career paths and made efforts to discuss career options with them and introduce them to others who could help facilitate their professional development,

*She helped us with the poster, but then beyond that, she wanted to further our careers in the future, which was really awesome. She wanted to show us every single opportunity that she thought would benefit us. We had a great relationship.*

Interns observed and were appreciative of the many efforts that their mentors and professional staff took on behalf of their internship, as described in the following exchange.

*Student #2: [Our mentor] definitely had a game plan the whole way. We didn't quite understand it, but he was guiding us. Every morning we meet with him, so he's set aside a lot of time to help us, especially with the poster. All last week, I think he spent three days, full days out of his-*

*Student #1: Daily work schedule.*

*Student #2: To be with us. He has been very hands-on.*

*Student #1: And even when he's not with us directly, he's editing our stuff for us on Google Docs and working. He's put in a lot of time and it's been much appreciated, especially with the level of data that we were working with. It sometimes was kind of confusing and so he was always there to shed a light on what was happening. He set up multiple ways that we could network, like options.... He just really set us up for success and made sure we had the resources we needed.*

The mentors themselves described the benefits of working with summer interns. For one, mentors were able to take on projects that they did not have the resources or staff to complete. The interns thus contributed to the work of the units that they were housed in, as shown in the discussion below. Mentors and their staff were also engaged in USGS in a broader way than they typically may be because they introduced the interns to the variety of facilities and opportunities within USGS that the mentors themselves did not typically interact with.

*Mentor #1: We ended up doing some things that we probably wouldn't have done over the summer or haven't done in the past. So part of what I would describe is an enrichment experience like a tour of the nuclear reactor here. My staff hadn't done that so arranging that for the students and my staff was really good for team building.*

*Mentor #2: Some things that have been continually pushed back, or off, actually got done because of this. We had to, in some ways, just kind of get our act together in preparation for the students. Like setting up a workstation that we've been*

*wanting to set up and those kind of things. Just kind of put us into a different gear or some of our operations, which was very helpful.*

The mentors also noted that it was productive for their own scientific team members to have summer interns. The teams themselves collaborated closely because of the interns and, thus, laid the groundwork for future projects. That students came to the agency with “fresh eyes” meant that seasoned employees needed to see their roles in a new way. The internship program allowed USGS mentors and their teams to re-engage with their work and peers.

*Mentor #1: I think the team building stuff was important. There is a lot of times when others in the group willingly offered some time and effort. I think overall the groups are pretty good helping each other out and stuff, anyways. But, just another opportunity for that and it's always encouraging to see that happen in the workspace.*

*Mentor #2: For us, this actually created an effort that will be helpful into the future. But, it's something that we probably wouldn't even have thought to have our staff work on. Mostly because of time and commitments. So it gave us a little bit of freedom to explore some new stuff.*

Mentors also gained valuable experience in mentoring and supervision:

*For myself, I haven't supervised many people, in recent years, anyways. So it was a good opportunity to interact [on how to take a] project forward, and learn a lot of things along the way. That was something that I enjoyed a lot and got a lot out of.*

Mentors also discussed the importance of project selection in defining the scope of work for interns and ensuring that they identified a project that can be successfully achieved within the timeline of the internship. For instance, one of the USGS teams thoughtfully shaped the project they had outlined to UNAVCO from an open-ended concept to a more focused project to ensure the interns could be successful. Even so, mentors found themselves learning as they went how to better structure the experience.

*Mentor #2: So when we submitted we actually had more of a broad, "Hey, we're gonna link additional information to this network and show some of the values behind that." And as we got closer.... I started thinking about, "Oh this is only eight weeks. I'd better give them a project versus give them a concept." ...It would've been pretty tough, I think, if we didn't have that narrowed focus.*

*Mentor #1: The things you might be able to get accomplished, will that get accomplished? Or what will come up along the way? It's kind of ... we found that out despite our best planning.*

The participation of UNAVCO from the outset was beneficial to the USGS mentors and staff. Through creating the structure of the project and also reviewing applications, the mentors began to invest themselves in the program.

*The outline was very helpful. I thought being part of the review process of actually determining who would be offered the internships was really valuable. Just to see the types of students that were potentially seeking these opportunities. And then after [that] I ended up being much more invested with the students that I said I wanted.*

Mentors also provided advice for structuring successful internships. For instance, mentors believed it to be essential that managers buy into future programs; without that active buy in, it could be possible for management to believe that mentors were slighting their work by participating actively in the internship program--which in and of itself was a demanding professional activity.

*Mentor #1: Yeah, I think that management involvement piece and management understanding what this is--*

*Mentor #2: --Is key.*

*Mentor #1: Yeah, and supporting it is really important. Especially since we were taking so much time. Rather than just saying, you know, "Oh we got some students and we're gonna dump them off." Which probably happens.*

As they reflected on whether or not they would consider participating in future programs, mentors appreciated the careful organization that UNAVCO brought to this project.

*Mentor #2: UNAVCO's being well structured made this a lot more successful than some programs.*

*Mentor #1: Yeah, I'll second that that. UNAVCO's being well structured made this a lot more successful than some programs that may not quite have things set up quite as well. It made it a lot easier in the end, and their staff was always there to answer questions, and things like that as well. And they had the program itself have an overarching goal at the end of it, which helped drive things forward, too.*

### **GLP Interns: Influence on Career Intentions**

The GLP internship helped students to discover the pathways and fields available to them in the geosciences, and thus to hone and narrow their own interests and aspirations. Based on their summer experience, interns clarified their professional goals, including interest in graduate school. Other scientists provided influence in the interns' decision making, particularly their views on pursuing graduate education, which previously had seemed uncertain. Three of the four were emphatically considering graduate studies as a result of the internship. Networking with

graduate students and professional staff provided navigational knowledge that had previously been unfamiliar to the interns, and provided vital information on pursuing future paths, such as graduate school, as indicated in the following exchange.

*Intern #2: I didn't know that people would pay for you to go to graduate school. I just thought, "I can't go to graduate school. That's too expensive." But, I didn't even consider it.*

*Intern #1: Everyone I've talked to this summer is like, "Do not pay for graduate school. Somebody will pay you to go." And I was like, "What? Nobody has told me this before. I had no idea." So that's definitely opened up my opportunities to wanting to expand my education, if I decide that's the path I want to go. But it's nice to have it as an option.*

Learning what they did not want to do was as powerful as gaining knowledge about what they did want to pursue professionally, as one intern noted: *"I didn't think I wanted to be a librarian, but now I don't want to be a librarian....So that's concrete now."*

In general, interns also affirmed their commitment to geoscience and were comforted that they had chosen the right field.

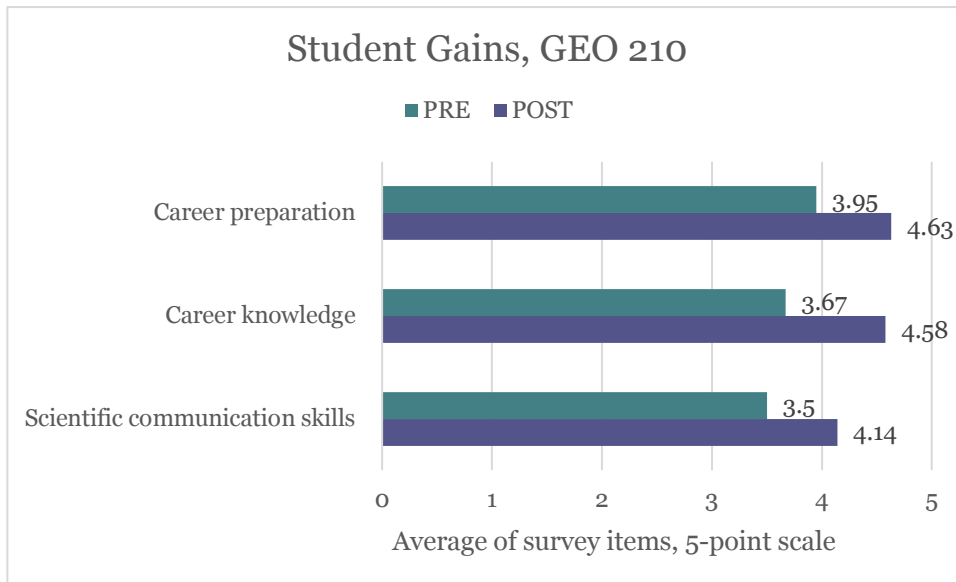
*I think that for me it reaffirmed that geoscience is the field I want to go in to. I'm still unclear as to what within that field I'm thinking. Obviously environmental science, but within that, hydrology. I appreciated that project we were working on touched on that and gave me some exposure.*

## **GEO 210**

Overall, students in GEO 210 made gains in all areas, with the strongest gains in career knowledge, similar to the pilot year of the course. Students also gained knowledge about geoscience career paths and scientific communication skills, particularly understanding geoscience research and how to communicate research findings.



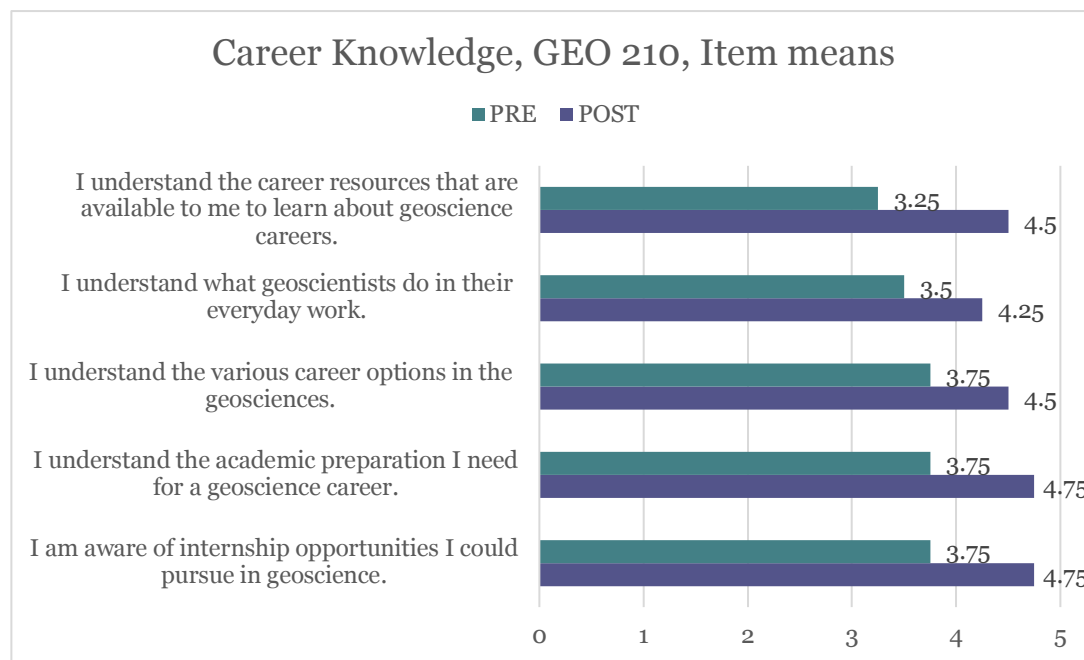
**Figure 5. Student Gains, GEO 210**



### **GEO 210: Career Knowledge**

Students gained the most from the GEO 210 course in their understanding and knowledge of geoscience careers. Students displayed the largest growth in learning about career resources that are available to them to learn about geoscience careers (e.g., the survey mean rose from 3.25 to 4.5 on a 5-point scale, or 50% of students agreeing to 100%). Students also gained a better understanding of the everyday work of geoscientists. Students became more aware of internship opportunities in their field and gained resources for learning about careers in the geosciences. Across the board, students learned about geoscience careers and gained a better understanding of the career paths available to them.

Figure 6. Career Knowledge, GEO 210, Item means



All four students stated that the most important thing that they learned from the course was about the wide variety of career options for geoscientists and about the many ways that they can gain professional experience in the geosciences. Students also gained awareness about the variety of ways that someone can navigate a career path in geoscience and felt comforted that there is not necessarily one way to do it. Students also appreciated the opportunity to learn about careers from actual geoscientists pursuing a variety of career paths. Typical comments from students were:

*“Aside from learning about all of the awesome internships, career opportunities, and Universities, I think the most important thing I learned is that no professional follows the same path to find the career they want or end up in. But along with that I now feel I have the skills and confidence to enter the field.” - GEO 210 student*

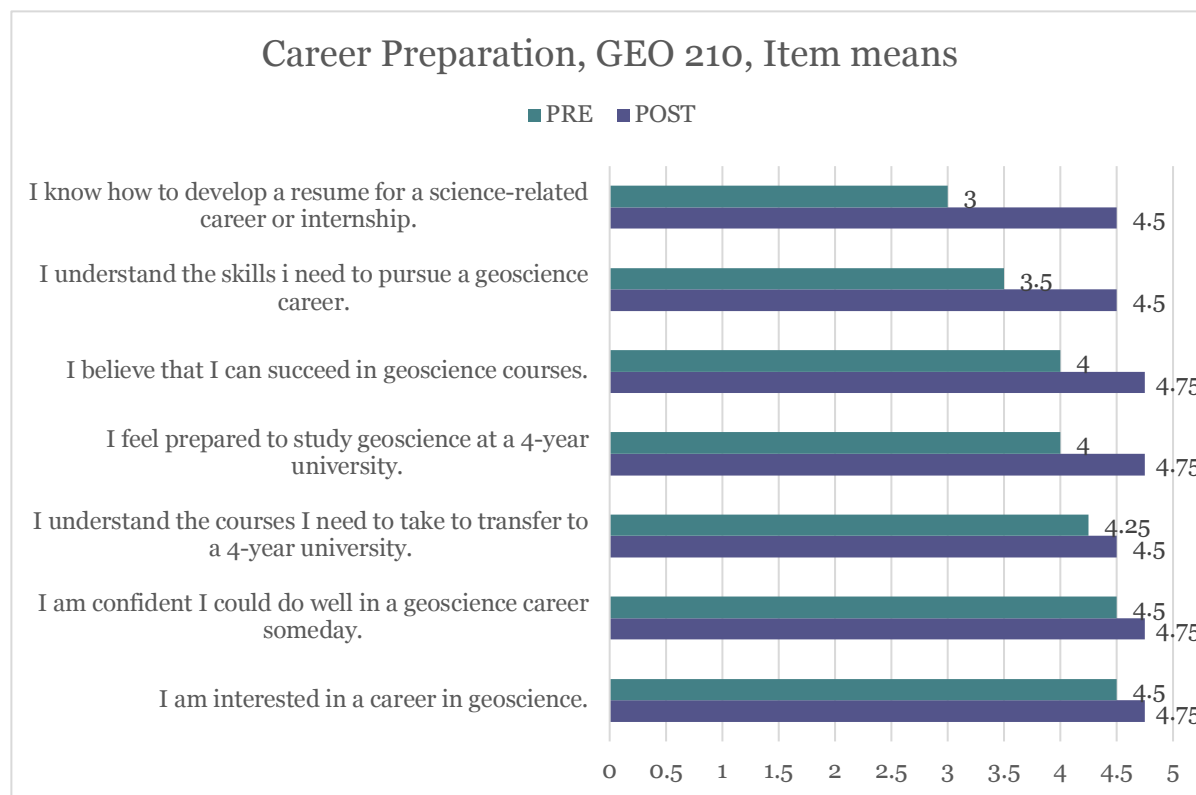
*“Learned from people who hold careers in geoscience in order to gain perspective on what they do for a living.” – GEO 210 student*

### GEO 210: Career Preparation

Students felt more prepared to navigate their educational and career pathway in the geosciences. Students entered the GEO 210 course with a higher level of career preparation than they did last year, yet they still demonstrated growth in their knowledge and preparation for geoscience careers. For instance, prior to the course, 50% knew how to develop a resume for a science-related internship or job, yet 100% could do so at the end of the course. Students also gained a better understanding of the skill set required to succeed in geoscience careers. Students also felt more confident that they could succeed in advanced coursework in geoscience. Students

demonstrated less growth in career interest or knowledge of transfer pathways in geoscience, but this was only because their incoming knowledge was so high.

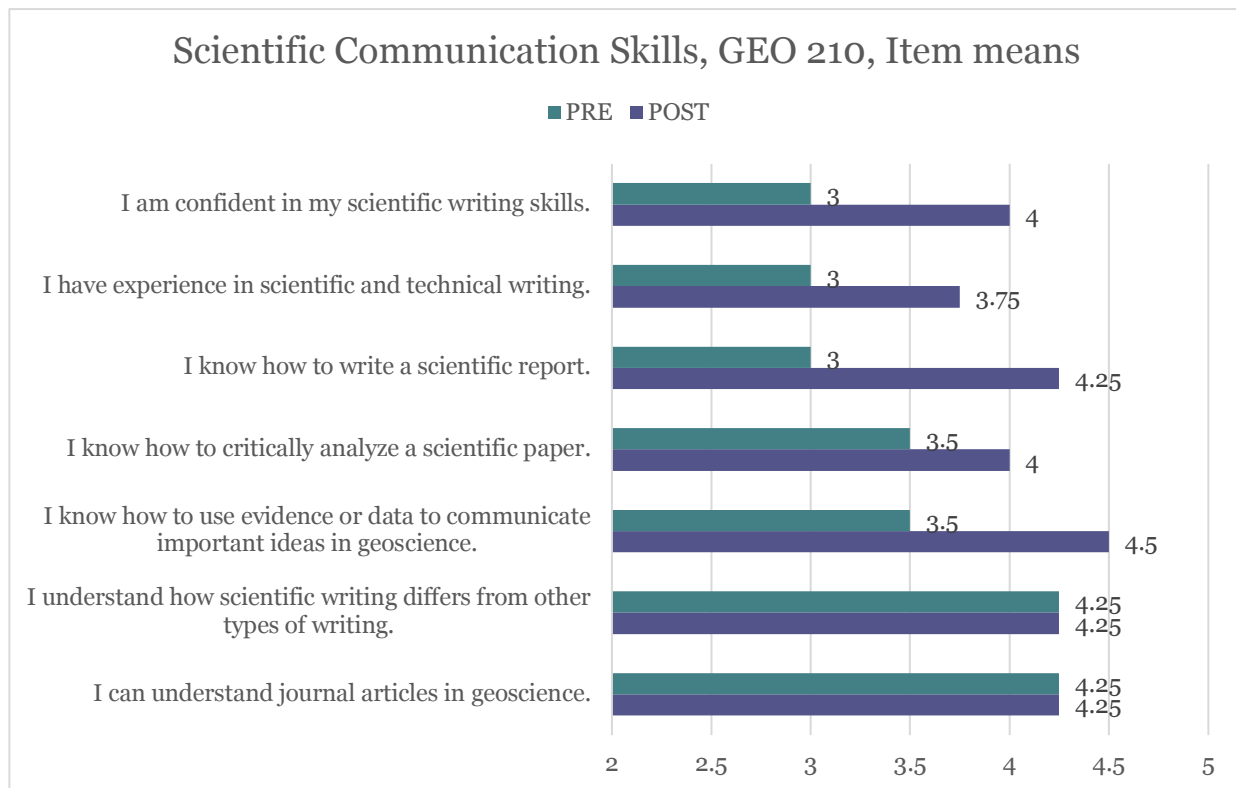
**Figure 7. Career Preparation, GEO 210, Item means**



### **GEO 210: Scientific Communication Skills**

Through the GEO 210 course, students gained a better understanding of scientific research and how scientists communicate their work. Students made the greatest growth in their understanding of how to write a scientific or technical report and in their confidence in their scientific writing abilities. For instance, only 50% of students were confident in their scientific writing abilities at the start of the course, while 100% were confident at the end. Students also felt more comfortable in their ability to critically analyze a scientific paper. On the other hand, students entered the course with a strong perceived ability to understand geoscience journal articles, and this ability held steady over the semester. The course was most helpful in boosting students’ confidence in their scientific writing and communication, providing experience in scientific reading and writing, and helping students to understand scientific and technical writing style.

**Figure 8. Geo 210, Scientific Community Skills, Item means**



### **GEO 210: Influence on Students' Educational and Career Paths**

All four students reported that GEO 210 had influenced their educational or career path in geoscience. Students were motivated and inspired to continue on their geoscience path and to take advantage of opportunities. For instance, one student was inspired to add a minor in Physical Geography. Most of all, students stated that it reaffirmed their commitment to a geoscience career and helped them to realize that that they were on the right path. In response to an open-ended question about the influence of the course on students' career paths, typical comments were:

*This course was the push I needed to make Physical Geography my minor. It really helped influence me to take the path of a career in geoscience. – GEO 210 student*

*Gave me a much more clear understanding of the opportunities I have in the geoscience field. – GEO 210 student*

### **GEO 210: Student Advice for Implementation**

Students were highly satisfied with GEO 210 and the career knowledge and preparation that they gained from the course. In an open-ended question, students were asked to comment on ways to improve the course. All four students responded that they would like the course to be longer to be able to go into even more depth about careers and what geoscience careers will

actually be like. Students suggested that the course run for more weeks or to lengthen class hours. Typical comments were:

*My only complaint is that [GEO 210] wasn't longer. I felt like we were just getting into some really interesting topics and the class was creating more valuable discussions. – GEO 210 student*

*More time, and perhaps more focus on actual careers and what they entail. However, this was an excellent course and I will highly recommend it to anyone who is considering a career in geoscience. – GEO 210 student*

## **Advice for future implementation**

As in previous years, students and faculty were very positive about the GLP offerings—internship and GEO 210—and the many benefits to students from these opportunities. The essential components of the GLP program continue to be exposure to career knowledge and pathways within the geosciences, professional development seminars and workshops, and exposure to scientific networking and professional skills. For the internship, in particular, students benefited greatly from the mentorship they received and the opportunity to create and present a scientific poster. All of these components help students to develop as future professionals and increase their ability to collaborate on a scientific project. Students and faculty provided the following advice for the program.

### **GLP internship**

- Interns and mentors had varying recommendations on the length of the internship according to the particular project undertaken. Interns and the mentor on one project, but not the other project, would have appreciated a longer internship, such as a 10-week internship. This particular project required more training and skill development, so interns and the mentor both stated that a longer time period, such as a 10-week internship, would allow interns to solidify their training and skill development while still providing time to complete the project and poster.
- Interns reported varying levels of interaction with their faculty mentors over the summer with one intern reporting no interaction. Students were very clear that having faculty support during the application process was crucial; however, the linkage during the project was not as strong. Despite their gains in knowledge of networking as a critical skill, the interns did not fully appreciate the potential for their community college faculty mentor to serve as part of their career development network, especially since most were anticipating transferring to a 4-year institution.
- Mentors noted that a project outline that they had created for GLP staff had not been shared with interns. Mentors suggested that this outline be shared with the interns in the future so that incoming interns would be more knowledgeable about the work that they would perform over the summer. This would also smooth the orientation and transition process for mentors and interns in the early days of the project.

- While personal relationships and the commitment of mentors were highly valued, communication across the various stakeholders in the GLP internship was not always clear. For instance, students did not realize the length of the commute they would undertake as part of the internship. Interns noted that they would have appreciated more up-front knowledge about the living and working arrangements for the summer.
- Additionally, future projects may want to address the time constraints placed on interns because of commutes. Project selection may consider the length of time that students are on site as opposed to participating in professional development at UNAVCO and/or commuting to the work site.
- Interns held some misperceptions about the setting in which the internship would be performed. These misperceptions led to some disappointment, even though all interns reported highly positive experiences. Nonetheless, interns had hoped to engage in some field work as part of the summer program.

#### GEO 210

- GEO 210 students requested a longer course, whether in more class sessions during the semester or longer class sessions during the abbreviated course. Either way, students requested more time in GEO 210 to learn about more careers and to dive even more deeply into career pathways and resources in the geosciences.

## Conclusion

For the past three years, the GLP program has introduced students from Colorado community colleges to geoscience career pathways, mentoring, networking, scientific communication, and the professional practice of science. From the GLP internship in summer 2018, students gained an understanding of the daily work of federal scientists and an appreciation of the vast array of geoscience career options within the federal government. As a result, almost all interns increased their interest in pursuing graduate studies in geoscience. Supplemental programming, such as Career Circles and professional skill-building seminars, developed students' professional skills and heightened their awareness of career pathways and options within the geosciences.

Similar to the GLP internship, the community college course, GEO 210, focused on geoscience careers, scientific communication, and professional development, without the hands-on exposure to professional practice engendered within the internship. Still, the course provided similar benefits to the internship, including increased understanding of geoscience career options, enhanced feelings of preparation for geoscience careers, and increased scientific communication skills. The only area where GEO 210 did not produce the same gains as the internship was in understanding and producing a scientific poster, mentoring and networking, and in understanding the everyday work of professional geoscientists. Thus, the Geo 210 course provided similar outcomes in many areas to the internship model, especially in understanding career opportunities and pathways.

In conclusion, the GLP program has created two professional development experiences for Colorado community college students, an apprentice-style internship and a college course focused on careers. Each of these experiences has a different duration and activities, and slightly different goals. Evaluation results have shown that these experiences are both successful in introducing students to the wide variety of career options in the geoscience and in raising their awareness of career resources and opportunities to facilitate their pathway in geoscience.