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External Evaluation of the Geo-Launchpad Internship Program, FRCC and UNAVCO, 2017

Geoscience opportunities
for community college
students

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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. This year, in addition to the GLP internship, a geoscience careers course (GEO 210) was piloted at Front Range Community College in spring.

Key evaluation findings from summer 2017 are:

GLP internship

Technical and research skills gains

- Interns reported the strongest growth in their knowledge of technical instrumentation in the geosciences and their ability to use it.
- At the beginning of the summer, no interns had a “strong understanding” of the major instrumentation in their discipline, while 57% did at the end of the summer.

Scientific communication skills

- Interns' second strongest gains were in the development of their scientific communication skills (survey mean rose from 3.71 to 4.35 on a 5-point scale).
- Interns' knowledge of how to prepare a scientific poster increased substantially (survey mean rose from 2.42 to 4.57 on a 5-point scale). Only one student reported the ability to create a scientific poster at the start of the internship, while 100% did at the end of the summer.
- Interns also made gains in their ability to explain geoscience concepts to a general audience, although they entered the summer with stronger beliefs in their abilities in this area (70% of students reported this ability at the start of the internship, while 100% did at the end of the internship).

Career knowledge, preparation, and aspirations

- One of the most meaningful outcomes from the internship, was the impact it had on interns' career direction and aspirations. All students reported that the internship had shaped their future career direction, whether influencing their decision to pursue graduate school or introducing them to a new sub-field within the geosciences.
- Interns learned about the career paths available in the geosciences. They also gained resources to learn about careers (survey mean rose from 3.71 to 4.29).

Intellectual and research skills gains

- Interns felt more prepared for a research experience at the end of the internship (28% of interns felt prepared to conduct scientific research at the start of the internship, while 72% did at the end of the internship).
- Interns gained an understanding of the breadth of research within the discipline of geosciences.

GEO 210 course

GEO 210: Career knowledge

- Students made the most growth from the course in their career knowledge, especially understanding career options, gaining access to career resources, and awareness of internship opportunities in the geosciences.
- 100% of students gained awareness of career options in the geosciences.
- 100% of students learned about career resources in the geosciences.
- The survey mean for understanding the skills necessary for a geoscience career rose from 3.5 to 4.5. In other words, at the beginning of the course, only two students agreed that they understood the skills necessary for a career in their field, while 100% agreed at the end of the semester.

GEO 210: Career preparation

- Students in GEO 210 also made strong growth in their preparation for more advanced study in the geosciences or a geoscience career.
- At the beginning of the semester, no students understood how to develop a resume for a science career or internship, while 100% of students had gained this capacity by the end of the course.

GEO 210: Scientific communication skills

- Students gained an understanding of how scientists communicate their findings through data and evidence.
- At the beginning of the semester, no students understood how to write a scientific report, while 100% of students gained this understanding by the end of the semester.
- 50% of students knew how to critically analyze a scientific paper at the beginning of the semester, while 100% of students could do so at the end of the semester.

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. Some of the essential elements 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 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 2017, the GLP program also piloted a 1-credit course at Front Range Community College (GEO 210) focusing on Geoscience internships and careers. The course introduced students to current research and tools in the geosciences and introduced them to various career paths and internship opportunities in the discipline. The course was offered in spring, 2017 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 benchmarks. The evaluation uses mixed-methods measures, including pre-post intern and student surveys and intern and faculty mentor 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 is not strictly a research internship, items were adapted to better fit the technical 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 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 summer interns. Surveys were administered at the beginning and the end of the course/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.

Faculty were interviewed in a focus group at the end of the summer internship to triangulate students' self-reports about their gains from the program and to assess the impact of the program on faculty mentor's careers and professional abilities. Students participated in a focus group interview at the end of the program to gain further detail about the impact of the program on their intellectual, technical, communication, professional skills, and educational and career goals.

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 Results

This section first discusses student motivations for participating in the GLP internship and then details the student outcomes from the course and internship. Next, results from the faculty mentor focus group are discussed and recommendations are provided.

Recruitment

The GLP Program is designed to serve Colorado community college students, both in the GEO 210 course and the internship program. The program recruited more applicants this year and selected eight students for the summer internship program. The career course was piloted in the spring semester and four student enrolled in the course that was delivered at Front Range Community College. Six of the eight internship students were from Front Range Community College, while one was from Community College of Aurora and one was from Community College of Denver. As in previous years, personal connections and networks continued to be important mechanisms for recruiting students. Most students were recruited by faculty members or through fliers distributed in their classes or campuses. One of the students from another campus heard about the program because her instructor also taught at Front Range Community College. One of the students learned about the internship from a job posting website. Thus, faculty are important in promoting the program and recruiting students.

Faculty mentors are a critical component of the program so it is important to recruit mentors as well. Faculty reported that they had learned about the program from the project PI, a faculty member at Front Range Community College, or through faculty colleagues who knew about the program. Some faculty members shared information about the program with other faculty in their department. Thus, word-of-mouth and personal connections are essential to recruiting new faculty mentors to the GLP program.

Students’ motivations for participating in the internship

Students chose the GLP program because they wanted to learn about career paths and options in the geosciences and they wanted insight into the actual work of professionals in the field. Students also hoped to gain technical and research skills.

I [wanted] to gain skills in networking and ways to support my career. I hope to meet others who are more advanced in their career and learn how they got there. I hope to work on some really interesting projects that expand my experiences and skills. –GLP intern

Student Demographics

Demographics of GLP interns

Eight students participated in the summer internship in 2017. Their demographic backgrounds are as follows:

- Five of the interns were women and three were men.
- None of the interns was the first in their family to attend college.
- Seven out of the eight interns work outside of their studies.
- Four of the students were enrolled part-time at their institutions, while the other four were full-time students.
- Seven interns plan to transfer to a 4-year degree program.
- Seven students were White/Caucasian and one was American Indian/Alaska Native.

Demographics of students in GEO 210

Four students enrolled in the GEO 210 course in spring of 2017. Their demographic information is as follows:

- All four are male.
- Three identify as white; one identifies as White/African-American/Native American.
- Two attend college part-time and two full-time
- Each has completed a different number of credits: 16-30, 31-45, 46-60, 60+
- All plan to receive an AA or AS degree, 3 in Geography and 1 in Natural Resources/Geography and three of the four plan to transfer to a 4-year university
- Two of the three students who plan to transfer cited an school they plan to attend: one said CSU and the other UNC
- All work at jobs; 2 work 21-30 hours/week, one 30 hours, and one 10 hours or less.
- The two part-time students work 21-30 hours/week.
- The student who seemed to make the most overall gains also went from being unsure about which school he would transfer to, to citing UNC

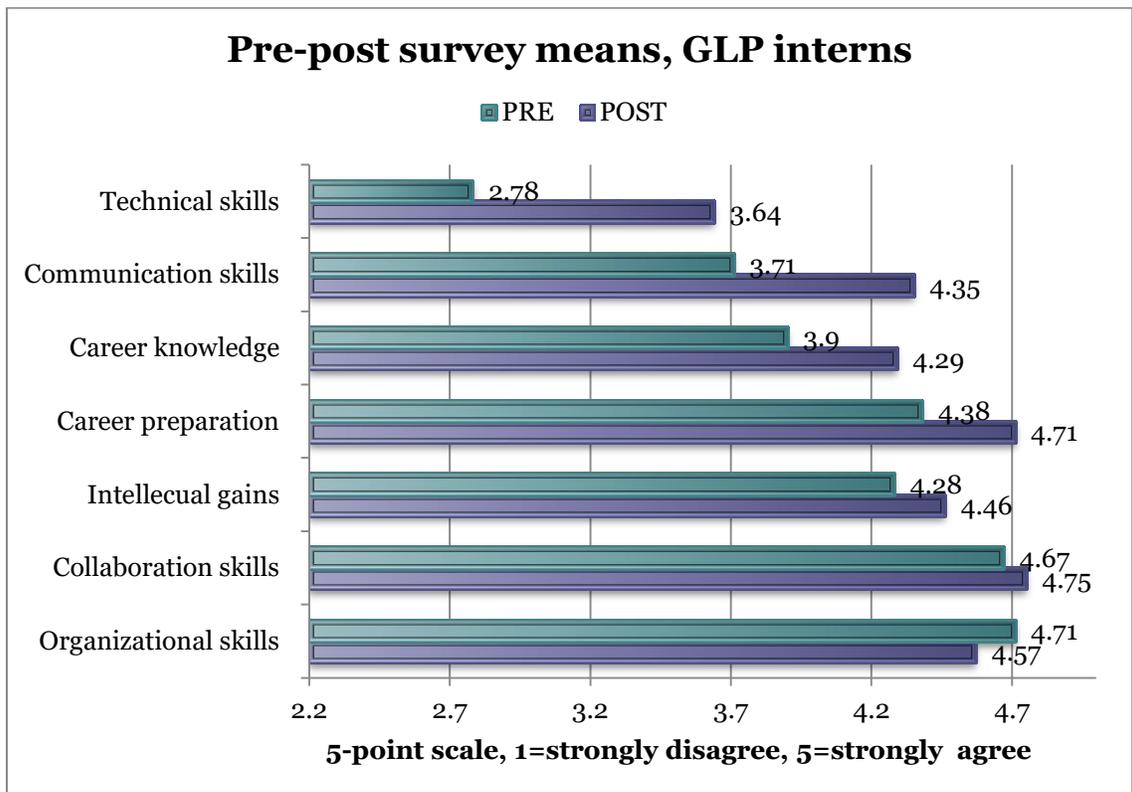
Student Outcomes

GLP Summer Internship

Interns made especially strong learning gains in the areas targeted by the GLP internship, including technical skills and knowledge of instrumentation, scientific communication skills, knowledge of career options, and preparation for careers in the geosciences. Students' strongest gain over the summer was in their understanding of

instrumentation in their field and their ability to use it scientific and technical instrumentation and tools (see figure 1). Students demonstrated the lowest growth in collaboration/teamwork and organizational skills, largely because they entered the internship with strong abilities in these areas. Nevertheless, in interviews, several of the interns described professional gains that they had made in these areas as well.

Figure 1. Pre-post means on survey scales, GLP interns



GLP interns: Technical Skills/Instrumentation

Students’ strongest learning outcome from the 2017 GLP internship was in their knowledge of technical instrumentation in the geosciences. The GLP internship introduced students to the instruments, techniques, and resources that professional geoscientists use in their daily work. Students’ knowledge and skill in using instrumentation increased substantially over the summer. At the beginning of the summer, no students had a strong understanding of the major instrumentation in their discipline, while 43% did at the end of the summer.

Nevertheless, there is still room for growth in their knowledge and abilities which is to be expected for early undergraduate students such as the GLP interns. Nevertheless, interns made the most significant gains in their understanding and awareness of the major instrumentation in the geosciences and their ability to use the equipment. This growth represents an important first

step in their development as geoscientists. Despite students' strong growth in this area, two interns rated their gains as substantially less than the others. These students were two of the five students placed USGS facility who, through their statements during the interview, seemed to have a less demanding project that provided less exposure to the array of technical tools, software, and instrumentation used by geoscientists. Still, all of the interns appreciated the exposure to the important tools used by geoscientists, as seen in the quotes below.

I've learned a lot of things, I mean, as far as, tangible things that you can learn. You know, there are a lot of different softwares and databases and things that we were exposed to. – GLP intern

It was a new experience. I had never worked with a 3D printer before. It's something that I'm pretty appreciative of because to me, it feels like it's going to be a pretty big technology in the coming future, and having experience with that, gives me a leg-up on other people. – GLP intern

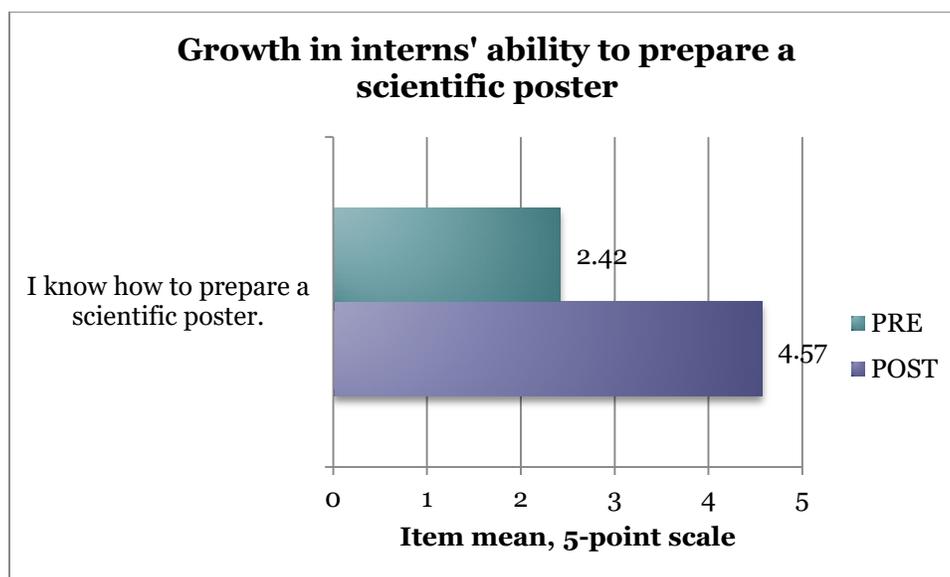
Basically I learned about new technologies that are up and coming that I would be better off having under my belt. Like GIS and the drone technology and programming skills. – GLP intern

In sum, students' strongest gains from the GLP internship were in their understanding of the important instrumentation and tools in the discipline. Interns were exposed to a variety of different tools which enhanced their understanding of the field, their technical skills, and their understanding of the work of geoscientists.

GLP interns: Communication Skills

Interns' second strongest gains were in the development of their scientific communication skills. In particular, interns displayed exceptionally strong gains in their ability to create a scientific poster since the mean for that item increased from 2.42 on the pre-survey to 4.57 on the post-survey. In other words, only one student reported the ability to create a scientific poster at the start of the program, while 100% of the students had acquired this skill by the end of the program.

Figure 2. Growth in interns' ability to prepare a scientific poster



Interns also made strong gains in their ability to communicate geoscience concepts to general audiences, most likely because of the addition of the outreach component to the program this year. Students were somewhat confident about this skill upon their entry to the GLP program; nonetheless, 70% of students reported this ability at the start of the program while 100% did at the end of the program. Clearly, students felt that they had strengthened this important skill. Still, students varied as to the value of the outreach component of the internship based on their prior presentation experience. Interns with more experience found less value in the outreach component, while interns with limited experience found it to be very valuable in strengthening their communication skills and increasing their confidence in communicating scientific concepts to the public. Further, interns drew upon concepts that they had learned during the GLP program while interacting with the public during outreach activities, as relayed in the story told by one of the interns during the focus group interview. Other interns also had similar experiences.

My team was doing a project where we were showing off how groundwater can affect earthquakes in California. We got a bunch of questions about fracking... and none of my partners really had experience with it because neither of them went on that field trip. So I was the person who was talking about that and kind of going off of what I remembered from Meghan's talk about forced induction earthquakes and I was able to explain. Well, that really, it's not when we're taking the oil out of the shale, that's not really what's causing these earthquakes in areas like Greeley or Oklahoma. It's really when we're pumping the waste water back down, that's causing that. I think that was pretty gratifying, like being, "Oh, I remember being taught about this and now I can actually go out and talk to other people about it too." – GLP intern

Faculty members also observed that their students had gained scientific communication skills from the internship. In turn, the experience that they gained in making presentations

increased their confidence and “pushed them out of their comfort zone,” as noted by one of the faculty members.

They're gently pushed out of their comfort zone I think, which you need. Every once in a while you got to get pushed out of that comfort zone. I think that's huge for them. Today, at lunch they were like, "Whew, I'm so glad we got through the presentations." That's good. A little bit of stress, pushing them a little bit. Now they got through it and they're like, "Okay, I can do that." – Faculty mentor

Therefore, GLP interns made substantial progress in their scientific communication skills, particularly their ability to create a scientific poster and communicate geoscience concepts to the public.

GLP interns: Career Knowledge

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 from the internship in their ability to access resources to learn about geoscience careers (students' responses rose from 3.71 to 4.29 on a 5-point scale, or from “not sure” to “agree”). Perhaps most importantly, interns learned that many professionals follow non-linear career paths and that there are many career options and possible routes to take along those career paths. Interns commented in the focus group interview:

Everybody has different career paths and it was kind of reassuring, especially for our group, which is kind of all on various different paths. – GLP intern

It's just the different pathways to different results. I feel like the thing that I got about careers in the geosciences are, you can take any number of routes and end up, and no matter what route you plan on taking, it could lead you somewhere else then. It was really great talking to a lot of the professionals that came in to tell us about their career path. That was an invaluable experience, definitely. It's not like a straight line, it's definitely not like that. - GLP intern

In sum, interns gained knowledge about the career options available to them and gained resources that can help them learn more about possible career paths. Interns also learned that career paths vary and that many professionals take circuitous paths along the way. Thus, interns gained knowledge about the range of career options in the field, yet were comforted by the fact that there is no single way to pursue any given career.

GLP interns: Career Preparation

From their technical work and projects, interns gained a better understanding of the daily work and lives of professional geoscientists. Interns learned about the balance between field work and office work in certain career paths, the types of tools and software used in the geosciences, and the importance scientific communication and collaboration within the geosciences. In fact, interns' strongest gains in career preparation were in their understanding of the everyday work of geoscientists (the mean on this survey item rose from 3.85 to 4.28, or from "not sure" to agree). At the beginning of the summer, a slim majority of students (57%) felt that they understood the everyday work of geoscientists, while 100% did at the end of the summer.

The GLP internship also prepared students for advanced study in the geosciences in their undergraduate education. In fact, the mean for the survey item related to feeling prepared for the next steps in their education rose from a 4.56 to 5.0 on a 5-point scale. At the end of the summer, 100% of students "strongly agreed" that they are "prepared to study geoscience at a 4-year university." In the focus group interview, students also felt that they had learned about and were more prepared for future out-of-class opportunities in their discipline, such as research and internships. From seminars and workshops, students also gained valuable skills in resume development, managing an online presence, and other aspects of becoming a professional. Some students mentioned that the development of their professional skills was the most significant aspect of the program for them, as shown in the quote below.

But I think the most beneficial thing was the professional development, the skills that we learned like resume building, how to network, how to manage your digital organization and things that I never would of even thought. All of these things were so, so helpful. ... They are things that we can take with us throughout the rest of our education and through our careers. – GLP intern

Students also gained a better understanding of graduate school and how to prepare for graduate school.

I have a clearer picture at this point, as far as like how I see my bachelors going and then the things that I need to do to prepare myself to hopefully, be accepted into graduate school. And you know, you get out what you put in and that's any and all experiences. So if you make yourself available and you really push, there's no reason why you can't get anywhere really. - GLP intern

Faculty mentors commented that students refined their career goals and increased their confidence that they could be successful scientists.

It was an opportunity to work in a professional environment. I think that greatly increased her confidence of being able to work in that type of environment, and then helped her shape her academic and career goals a little bit more specifically. – Faculty mentor

In conclusion, students felt more prepared for a future career in the geosciences because of their experience in implementing a technical project under the supervision of scientists.

Students also felt that the career circles and other professional development activities enhanced their preparation. Students also felt more prepared for advanced study in the geosciences.

GLP interns: Intellectual Gains

Interns reported fewer intellectual gains than they did in other skills domains, as their conceptual understanding of the discipline remained relatively steady over the summer. Nonetheless, interns developed a more sophisticated understanding of the process of science, especially that it is slow process that moves in fits and starts, and can be ambiguous. Interns reported the strongest gains in their readiness to pursue a research experience in the geosciences. In fact, the mean for that survey item increased from 4.14 to 4.72 on a 5-point scale. In other words, 28% of students strongly agreed that they were ready for research at the beginning of the summer, while 72% felt so at the end of the summer. The comments from focus groups reflect that students appreciated the exposure to research that resulted from their interactions with graduate students. From these interactions and their technical work on their project, interns developed a better understanding of the scientific research process. Interns also learned about the breadth of research questions, topics, and methodologies that fall within the geosciences.

[I learned that] science is this really, really, really long process. The more experience the scientist that we seem to meet, or the more they seem to know, then [I learned] what a long process it is. – GLP intern

I would say that there was really amazing exposure to the research that's happening now. We've had so much contact with grad students. There's just a lot of exposure ...Within those fields, which are very broad. It's sort of like, there's a fit for everybody, whatever your passion is. – GLP intern

In conclusion, rather than gaining a deeper understanding of specific concepts in their discipline, interns gained a better understanding of the nature of scientific research and increased their readiness to pursue research experiences.

GLP interns: Collaboration/Networking

Although survey results indicate that students made only slight gains in collaboration and networking, this area was one of the more prominent topics within the focus group discussion. Interns discussed the growth in their ability to work as a team member, to feel comfortable in networking with professional geoscientists, and how they came to recognize the importance of networking within the scientific community. As suggested in the typical comment below, students became more comfortable in working in teams and learned how to more effectively collaborate on scientific projects.

I learned a lot about working with other people. Being kind of an introvert, I'm used to doing my own work, working by myself. So, how to effectively work in a team, is something that I learned about. – GLP intern

Besides the opportunity to learn to collaborate and network with professional scientists, interns benefited substantially from opportunities to network with graduate students. From these interactions, interns learned more about the work of graduate students and began to view the graduate students as resources. Field trips were important for helping to facilitate interactions and networking between the GLP interns and their more advanced peers.

I think just the exposure to different grad students and getting to know how to approach people about questions you have. About how to approach people about things that you want to do. Just networking. – GLP intern

That was the good thing about the field trips, was that everyone was together. It was really cool to get to interact with interns that are further advanced into their education. It was a good chance to bounce ideas off of them and hear about where they're at and maybe struggles that they're having or advice they have to give. – GLP intern

Interns also gained strategies for expanding their networks, such as conducting informational interviews.

I feel like maintaining strong networks is really important. Knowing the right people. We talked about informational interviews at one point, getting information about an industry or a company or whatever. Kind of understanding that, I think really helps make career plans. And kind of direct where I'm going, at least for my future.

Faculty mentors commented that students gained confidence from networking which, in turn, boosted their confidence that they could succeed in the discipline. For example, one of the mentors noted that his student had been nervous about transferring to a 4-year degree program and was now much more confident because of her experience in the GLP program.

It's more about the connections she made with people both formally and informally. She has a lot of anxiety about going from community college to four year school. She starts at CU in a couple weeks. Working with the graduate students, working with the upper division undergrads, I think those things were really beneficial to alleviating some of her stress and getting her excited about that transition. – Faculty mentor

In conclusion, the GLP program provided interns with multiple opportunities to network with scientists across the educational and career spectrum. In addition, the program equipped students with resources and strategies for expanding their own networks.

GLP interns: Mentoring

Interns received mentoring from faculty members at their home institutions as well as UNAVCO and USGS scientists who supervised their summer projects. Thus, interns felt supported in their everyday work over the summer and in their future educational and career paths. In particular, interns felt that the scientists and staff at UNAVCO were highly supportive of their development as scientists, as shown in comments from the focus group interview.

I think that everyone at UNAVCO did a really great job with [mentoring]. It seems like they're very, very invested in cultivating a great batch of future scientists and they very much care about enhancing our knowledge as much as they possibly can, which is really nice.- GLP intern

Two of the five interns placed at USGS had some confusion about their project initially and both expressed that they would have liked more direction from their supervisors and a more well developed project that was more challenging. This concern was not shared by the other USGS interns, only by one of the project teams placed there. For instance, one of these students commented:

*I figured out a project to the best of my ability but I don't know. It was fun, it was good and it turned out great but I just, I would have liked better direction. I would have liked more communication. I would have liked more of a solid plan.
– GLP intern*

Still, interns appreciated the mentoring and guidance that they received from their faculty mentors and project supervisors.

GLP interns: Organizational skills

Surprisingly, given the breadth and depth of their projects undertaken over the summer, interns declined slightly in their perceptions of their organizational skills. This is largely because they entered the program with exceptionally strong skills. Nonetheless, in the focus group interviews, interns acknowledged that they had never undertaken such a large project before and that it was beneficial to organize and plan a complex project from start to finish. For instance, one the interns commented:

There's something to taking a project from the beginning and running it all the way through, into the part where you were presenting a poster, that I think is very invaluable. That is an experience that I had not had. – GLP intern

GLP Interns: Influence on Career Intentions

The GLP internship helped students to discover a fitting sub-field or educational path for them in the geosciences. Students' interest in geoscience careers increased, as did their commitment to pursuing a geoscience career path. Most importantly, several interns were introduced to the sub-field that they wanted to enter or came to recognize which area of geoscience as a good fit for them.

I was gonna to be going to geospatial science and then I was like, "Yeah but there's really." I came to realize, there's really no point in going because I really like meteorology and atmospheric science is kinda my passion. – GLP intern

Interns also clarified whether graduate school was the right path for them, a goal that some of them had decided they would pursue as a result of the GLP internship. Interns credited their decision to pursue graduate school to the emphasis placed on advanced studies in the GLP program.

Well, something that I think I changed is, I was always floating around the idea of grad school but I think I'm fairly certain that I'll go to grad school now. – GLP intern

Interns gained confidence that they could be successful in a geoscience career or educational program. Gains in confidence were particularly important for older students returning to college.

I feel like one of the most important things I'm taking away from this is... I was really intimidated when I first started like, "Oh my gosh, everybody knows way more than me." Everybody's more like an actual scientist and I don't know as much. I almost feel like a different person after this experience. I feel more confident in pursuing my goals and in making my thoughts be known. Just the experience of working with people in a collaborative, science environment. – GLP intern

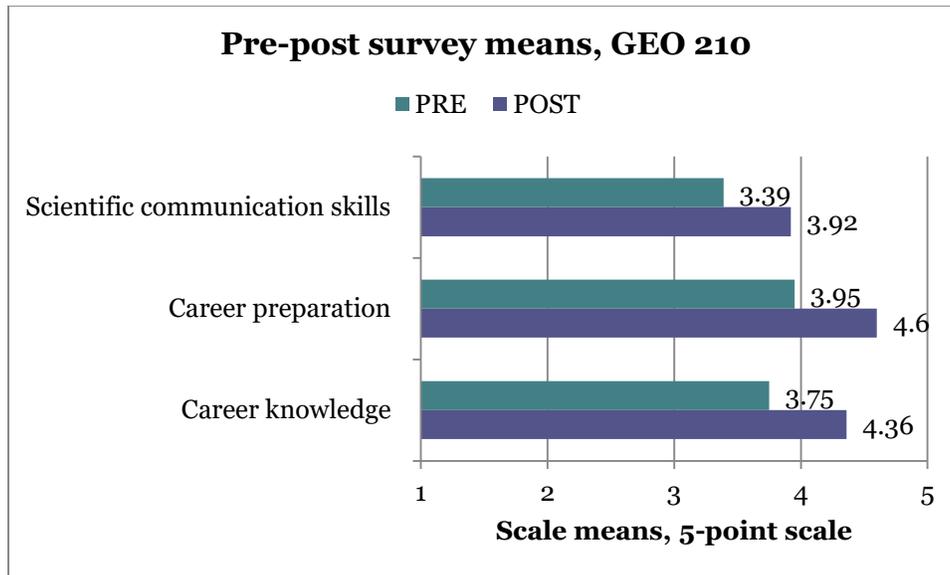
Faculty mentors observed that the GLP program helped interns to refine their career interests, or to narrow their interests to a particular sub-field or career path within the discipline. Mentors also noted that the program strengthened students' commitment to a geoscience career. Because students were immersed in the daily work of scientists, many of them confirmed that they were on the right career path, as reflected in the following comment from a faculty mentor.

I think she was just excited to see what you all just do every day and who they are, and that she is on the right path to what she thought she wanted to do. I think it was really, it seems like it was really good for her in that aspect, kind of reaffirm what she was doing. – Faculty mentor

GEO 210

Overall, there were gains in all areas, with the strongest gains in Career Knowledge. Not only was this reflected in the responses to career knowledge questions, but all four 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 geosciences careers and the academic preparation they need to enter them.

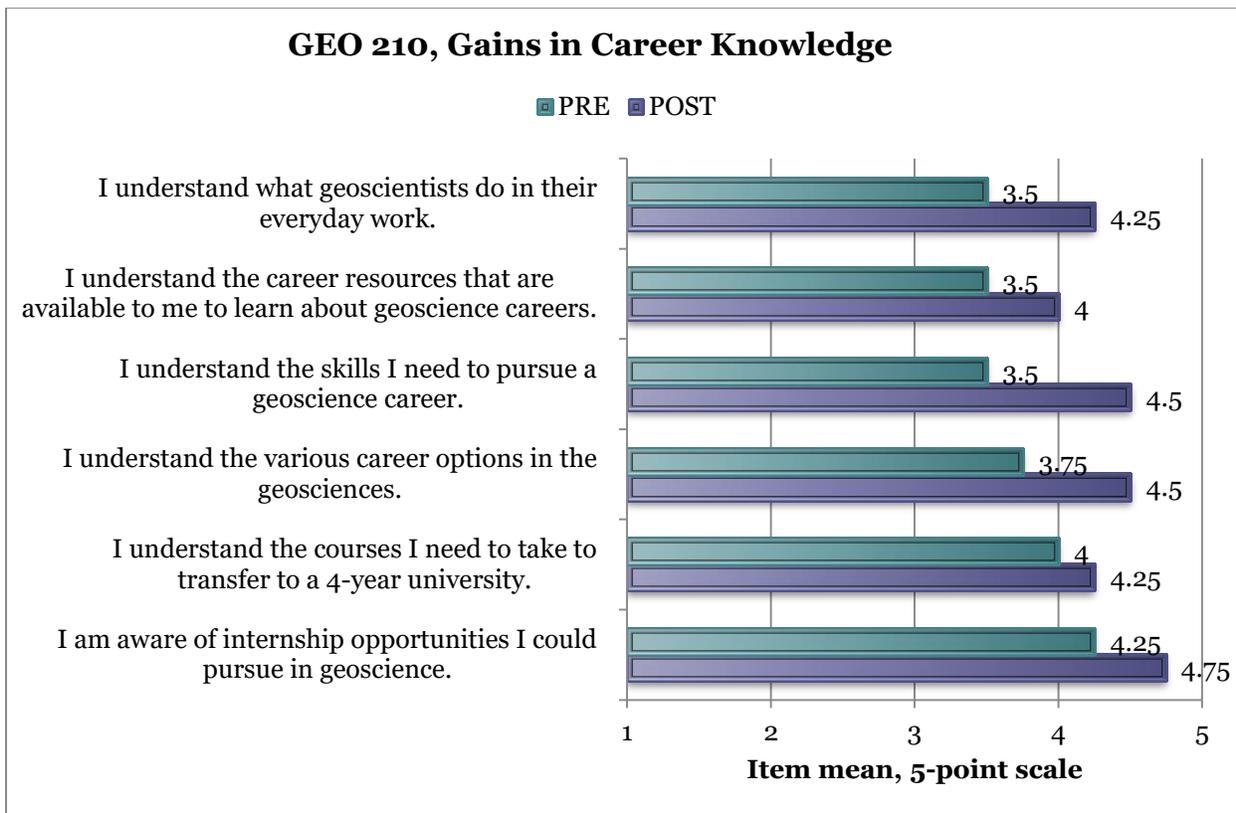
Figure 3. Pre-post survey means, GEO 210



GEO 210: Career Knowledge

Students made the greatest gains on the survey in the area of career knowledge. In fact, students made the largest gains in understanding the skills that they need for a geoscience career (e.g., the survey mean rose from 3.5 to 4.5 on a 5-point scale). At the beginning of the course, only two students agreed that they understood the skills necessary for a geoscience career, while 100% of students agreed at the end of the semester (and half of these students strongly agreed). Students also gained a stronger understanding of the career options available in the geosciences. Students gained awareness 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.

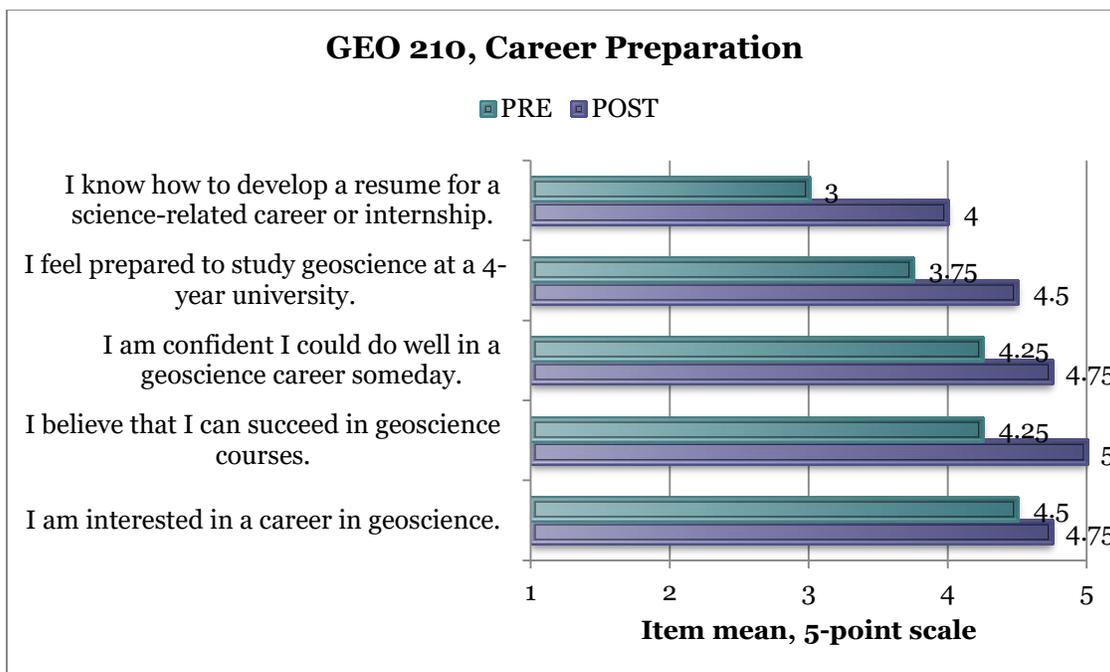
Figure 3. GEO 210, Gains in Career Knowledge



Career Preparation

Students made strong gains in their sense of preparedness to pursue advanced studies in the geosciences or a geoscience career. In particular, students learned how to develop a resume for a career or internship in the sciences. For instance, at the beginning of the semester, no students understood how to develop a resume for a science career or internship, while 100% of students had gained this capacity by the end of the course. Students also gained confidence that they could succeed in future coursework or a geoscience career. Students' interest in geoscience careers did not increase much, but this is largely because they entered the course with strong interest in pursuing a career in their field.

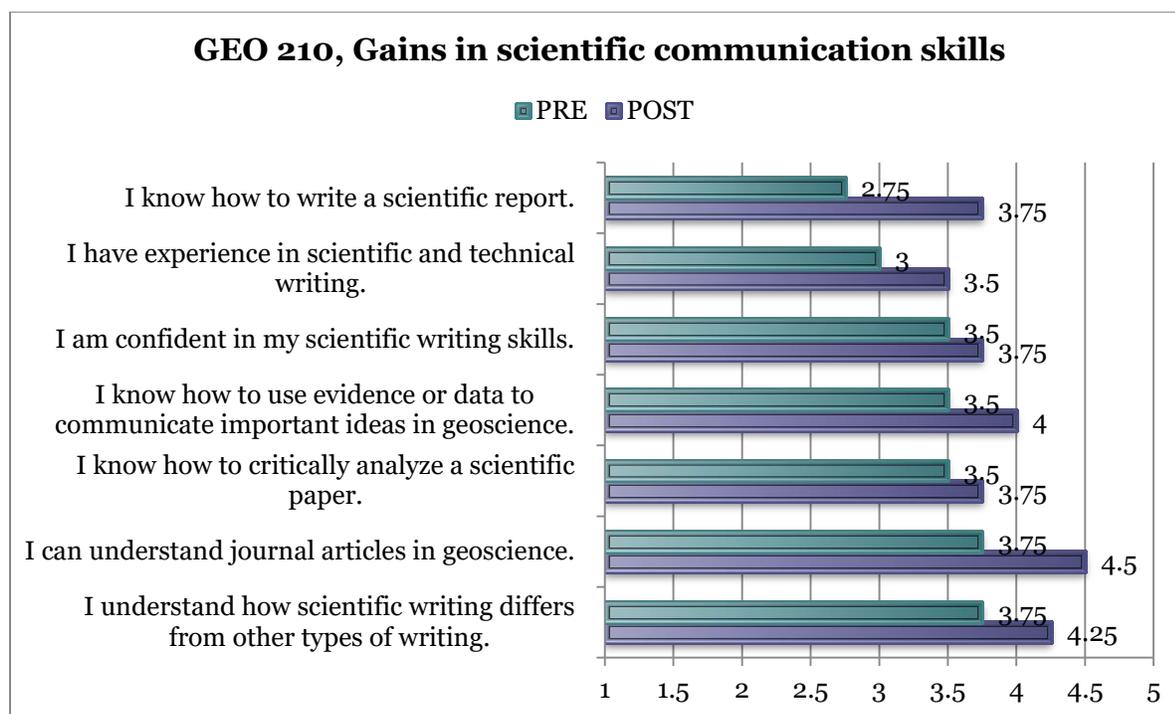
Figure 4. Geo 210, Career Preparation, item means



Scientific Communication Skills

Through the GEO 210 course, students gained an understanding of scientific communication. Specifically, students increased their understanding of how evidence is used to make scientific arguments and how scientific writing differs from other types of writing. Students showed the most growth in their understanding of how to write a scientific report (mean increase from 2.75 to 3.75 on a 5-point scale). At the beginning of the semester, no students knew how to write a scientific report, while 100% of students understood how to write a scientific report at the end of the semester. Moreover, 50% of students knew how to critically analyze a scientific paper at the beginning of the semester, while 100% of students could do so at the end of the course.

Figure 5. Geo 210, Gains in scientific communication skills



Faculty Outcomes

The GLP internship had a positive impact on faculty mentors as well. Community college faculty members learned more about UNAVCO and its function within the geoscience community and gained a better understanding of the breadth of projects undertaken within UNAVCO and USGS. Faculty mentors also noted that their involvement with the program had enhanced their own professional development. For instance, many mentors commented that their mentoring skills had increased. The faculty were receptive to learning more about mentoring and enhancing their skills in this area as it was an important aspect of their work in higher education.

That's actually good for me to develop my career, because that's one of my focuses is to mentor students out in these programs, getting them into careers. That's the end game. Any way I can develop as a mentor, I'm all in. – Faculty mentor

Program implementation: Recommendations from students and faculty

Similar to previous years, students and faculty were very positive about the structure of the GLP benefits and its many benefits for students. The critical components of the GLP program continue to be the scientific work undertaken by students, particularly the networking that resulted from interacting with scientists; professional development seminars and workshops; field trips and interactions with students from other programs; and the opportunity to create and present a scientific poster. All of these components shape students as future professionals and increase their ability to collaborate on a scientific project. Students and faculty provided the following advice for the program:

- Provide a seminar on graduate school (e.g., application process, GRE, fellowships, the structure of the Ph.D. experience , etc.)
- Students would like to learn about geoscience programs at other universities (besides CU-Boulder) in Colorado (e.g., Mines, UNC, CSU, etc.)
- Word of mouth and personal connections are important for recruiting both students and faculty mentors

Advice for future implementation

- Students emphasized the importance of project selection for successful internships. Two of the interns at USGS expressed that their project could have been more structured with clear guidance, yet also more open-ended and challenging. Achieving the right balance of structure, guidance, and open-endedness is difficult, yet enhances student outcomes.
- Students also reported that the outreach activity could be more structured. Students requested more guidance implementing the outreach activity, such as more assistance in helping the group get aligned and on task with each other. Students reported that the ping pong ball activity was the most effective training activity.
- Mentors requested more information about mentoring on the front end, especially resources about mentoring to help them in their work.

Conclusion

In conclusion, from the GLP internship, interns gained an understanding of the daily work of geoscientists, gained the ability to use some of the major instrumentation in their field, and gained greater awareness of the breadth of career paths within the geosciences. Perhaps most importantly, most of the interns refined or narrowed their career focus to a specific sub-field within the geosciences. A few interns were inspired to pursue graduate school because of the strong emphasis placed on graduate school by the internship. Career circles and professional

seminars continued to build students' professional skills, such as resume building, networking, and career awareness.

The program piloted a community college course focused on geoscience careers, scientific communication, and professional development. The course offered similar benefits to the internships, with the exception of the understanding of the work of scientists that comes from working side-by-side with scientists on real projects. Nonetheless, students in the GEO 210 course made strong gains in their awareness of career options in the geosciences, their capacity to develop a science-related resume, and in their ability to read and analyze scientific research in their field. Thus, the Geo 210 course provided similar outcomes to the internship model.

Appendix

GEO 210 students' open-ended question survey responses

The GEO 210 appears to have influenced students' career paths and their confidence in pursuing a geoscience career. There was a noticeable difference in the specificity and confidence with which all four students articulated their plan in the post-survey. One student declared that he planned to earn a GIS certificate which he said he was "thinking about" in the pre survey. The course appears to have influenced these career shifts. Students' post-survey responses cite gains in knowledge about geoscience careers that enabled them to focus their interests and to understand what they need to do to pursue specific areas of the geosciences academically and professionally. According to their open-ended survey responses, students not only gained knowledge about the geosciences but also awareness of and strategies for getting on "the right path for success and preparation." For instance, students reported that they learned about writing scientific papers, gained awareness of internship opportunities, and the kinds of geoscience careers available. These gains matched well with the goals for the course that students reported on the pre survey, such as gaining knowledge about internships and careers, narrowing career interests, and learning more about educational preparation and employment requirements.

Student suggestions for improving GEO 210

Students had few suggestions for improving the course, indicating their overall satisfaction with it. Two students offered the suggestion that they would like to have more speakers. One of those students specified that he would like visits from local 4-year university faculty as well as geosciences professionals.

Figure 6. Students' open-ended question survey responses

	Pre	Post
What are your current career or educational plans?	Current educational plans include getting my Associate's while working part time and then transferring to a 4 year institution, that being either CSU or UNC, and obtaining a Bachelor's while finding internship and possibly work opportunities in the geoscience field. Also thinking about getting a GIS certificate.	I want to earn my GIS certification from Front Range Community College and am also interested in pursuing a career in a GeoScience field such as in the Climatology, Environmental Science or Physical Geography field perhaps doing research. I would also like to use my Geographic Information Systems certification to do cartography or related digital map making projects.
	To finish up courses in Physical Geography and become GIS certified. I	My current educational plans are to complete my 2 year degree before

	would like to help design maps as in Cartography for ArcGIS.	transferring to a 4 year institution while working to lessen student loan debt.
	My current plans in pursuit are to obtain an associates of arts with a geography focus. I also plan on pursuing GIS courses in the form of either a certificate or bachelor's degree. I'm also interested in any other bachelor's degree that pertains to all aspects of the geoscience field of study.	Obtain a degree in geomorphology and a certificate and GIS
	Finish A.A., transfer to 4 year college, pursue geoscience internships	Finish a A.A. in December 2017, transfer to UNC the next year to complete a Geography degree with an emphasis on GIS
What do you hope to gain from this course?		
	Knowledge about geoscience careers and internship opportunities. Hopefully narrow down my interest in careers before I graduate.	
	A better understanding of the skills needed and resources necessary for finding and beginning a career in the Geoscience realm.	
	The knowledge to align my education received to a job in the geoscience field.	
	I hope to gain a leg up on a normal sophomore in regards to preparing to transfer to a 4 year and gaining a career post-college	
How did this course influence your career or educational plans?		
		It helped me narrow down the areas in which I want to work and opened up some pathways of knowledge about the Geosciences and potential career opportunities I am interested in pursuing. I also feel more confident going forward that I can write a better scientific paper than I have in the past.
		It solidified my interest in the geosciences and showed me the opportunities that are available to me as well as showing me, briefly, what a career in the geosciences is like.
		This course helped me understand requirements and abilities I would possibly need to pursue a geoscience career.
		Shabram's GEO210 class clarified what

		is out there for jobs in geosciences and how best to prepare for the workforce.
What was the most important thing that you learned in this course?		
		That I definitely want to pursue a career in the GeoSciences and that I now have avenues to direct me in the right path for success and preparation related to this field.
		The most important thing that I learned in this course is the amount of internships that are available to me and how to apply to them.
		To be prepared if an opportunity comes along, by taking initiative upon myself
		I feel like learning about the characteristics of a scientific journal essay was important, as it is something outside of what people normally read, but once you understand the format, comprehending them are much easier
How could this course be improved?		
		Perhaps speaking with or having another Geography Professional from another University like Northern Colorado in Greeley, come participate in one of our classes to speak to us about specific career related fields of interest. Otherwise I really enjoyed the class and found it very insightful.
		More speakers, but that's sometimes hard to set up around other people's schedules
		This course was very organized and straight forward. I see no need for improvements from my point of view.
		I honestly cannot think of a significant improvement to the course.