
The Berkeley Collegium

Narrowing the Gap Between Teaching and Research Grants Program

Assessment of First Cohort of Grant Recipients (2015-2017)



Projects Awarded

The first call for proposals in this grants program went out in the spring of 2015, and resulted in our funding the four projects for the 2015-2017 period. Details of each project are provided below:

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|--|--|--|---|---|
| Title | Intellectual discovery through field-based student research projects in Death Valley | GC-Maker: Building your own analyzer for environmental research | The UC Berkeley-Owens Valley Paiute Project: Restoring a lost cultural heritage | PREP-IP: Research experiences for work-study engineering students in their first year at Berkeley |
| Recipient | Nicholas Swanson-Hysell Earth & Planetary Sciences | Robert Rhew Geography | Patricia Steenland College Writing Program | Oscar Dubon Engineering |
| Award Amount | \$29,516 | \$30,000 | \$24,000 | \$28,000 |
| # of students impacted 2015-16 | 16 | 3 (in pilot, but 11 currently, see below) | 17 | 14 |
| Anticipated # of students impacted in 2016-17 | TBD in 2017-18 (gap year to replenish pool of interested students and will re-run) | 11 | n/a (will use remaining funds to sponsor related activities of formal course) | n/a (not enough funds to offer full program again, but offering various facets to groups) |
| Sampling of enrolled majors | geology, marine science, chemical engineering, integrative biology | geography, chemistry, civil & environ. engin., atmospheric science | anthropology, engineering, natural resources, MCB, physics | all students were drawn from the Pre-Engineering Program (PREP) |
| Gender distribution (% women) | 40% women | 38% women in Fall 2016) | 50% women | 50% women |

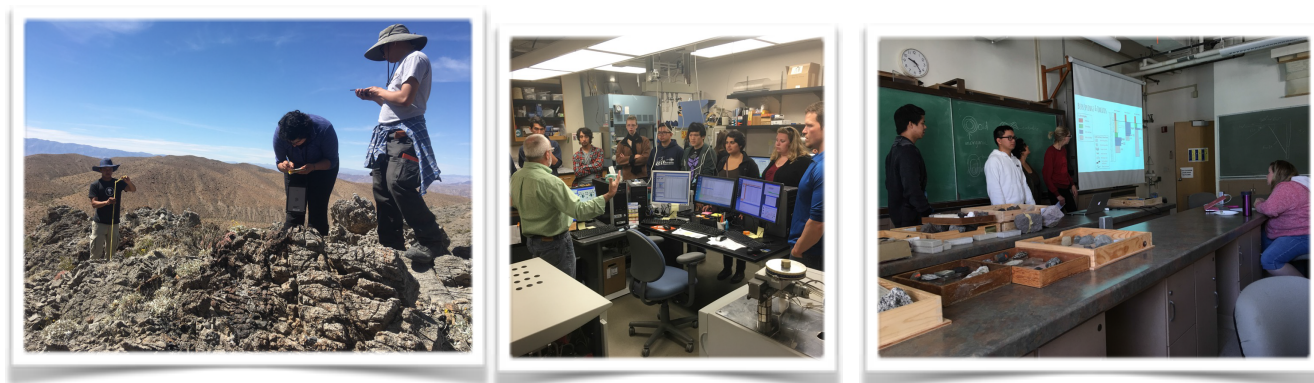
Progress Reports and Assessment

We obtained brief progress reports (i.e., short narratives and budgetary updates) from the awardees at the end of the Fall 2015 and Spring 2016 terms, and hosted a forum at the end of the first year (May, 2016) where each awardee presented their progress and/or outcomes of their project to date.

To conduct a more systematic assessment, we then developed an interview questionnaire and protocol which Professor Chen administered to each awardee over the Fall 2016 term. The contents of this document largely reflect the verbal and written information conveyed in these interviews.

Intellectual discovery through field-based student research projects in Death Valley

Nicholas Swanson-Hysell (Earth & Planetary Sciences)



This project integrated a substantive field study research experience into an existing course taught within the Earth and Planetary Science Department entitled “Stratigraphy and Earth History” (EPS 115). In contrast to field trips that are conducted in a “show and tell” style focused on transmitting content, this project provided students with a legitimate research enterprise focused on student-led discovery. Students in the course conducted research projects in small groups within an impressive natural laboratory for Earth Science—Death Valley—in the context of an 8-day field trip. Death Valley is a natural laboratory for the understanding of a crucial period of Earth history known as the Neoproterozoic, when animals emerged on Earth’s surface and during which there were the most extreme shifts in climate that have been documented in the geologic record. The combination of well-exposed rocks in Death Valley and their connection to some of the most exciting research avenues in Earth history today make these rocks an exciting focus for proposing and testing hypotheses.

For the Death Valley trip, held over spring break during the Spring 2016 semester, students were accompanied, supervised, and mentored by Dr. Swanson-Hysell, another faculty member, and a graduate student. Students worked on research projects in small groups collecting field data and samples. Students were then able to generate data within labs in the EPS Department and Berkeley’s Center for Stable Isotope Biogeochemistry. In this way, the course was able to replicate the arc of the research trajectory. Throughout the course, including before, during, and after the field trip, students obtained direct experience with each phase of scholarly research.

Learning Outcomes & Goals

- Learn to formulate novel (entirely student-driven) research questions about how the Earth works that can be tested with field and laboratory data
- Learn to make informed observations of the natural world during fieldwork

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- Learn to apply computational methods to analyze data and extract information to evaluate hypotheses
 - Learn to communicate research results and discoveries using the same tools applied by those publishing research in the discipline

Impact on Nicholas Swanson-Hysell

Through my research I strive to better understand Earth's systems and the history of their interconnections through study of the rock record. My goal, in current and future teaching efforts, is to enable students to do the same. The importance of an interdisciplinary approach to advances in the geological sciences demands that the current generation of geoscience students are trained with an approach that combines field-based exposure to geology with the quantitative skills necessary to apply geochemical and geophysical data to problems in the Earth sciences. By crafting meaningful exercises in the classroom, the field, and the lab, I strive to give students the tools to formulate questions about the Earth and enable them to seek answers through the generation of new observations and data. The support of the Collegium Funds enabled me to both realize these goals and provided impetus to implement them. Bringing teaching closer to research takes significant planning, effort and resources. Having an infusion of resources in conjunction with the instruction of this course allowed these pedagogical goals to become realized and gave me valuable experience as I continue to seek to bring such research project experience into future courses.

Course Evaluations

We were able to obtain ratings for this course prior to adding the Death Valley research component (2015, n = 16), as well as ratings from the Collegium-supported version of the course (2016; n = 9). All ratings were made on 1-7 point scale, with higher numbers being more favorable; means are reported below.

1. Considering both the limitations and possibilities of the subject matter and the course, how would you rate the overall effectiveness of this instructor?

- 2015 (without Collegium support): 6.1
- 2016 (with Collegium support): 6.9

2. Considering both the limitations and possibilities of the subject matter and the course, how would you rate the overall effectiveness of this course?

- 2015 (without Collegium support): 5.7
- 2016 (with Collegium support): 6.9

3. The instructor presented content in an organized manner

- 2015 (without Collegium support): 5.8
- 2016 (with Collegium support): 7.0

4. The instructor explained concepts clearly

- 2015 (without Collegium support): 5.9

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- 2016 (with Collegium support): 6.8
5. The instructor was helpful when I had difficulties or questions
 - 2015 (without Collegium support): 6.0
 - 2016 (with Collegium support): 6.9
 6. The instructor provided clear constructive feedback
 - 2015 (without Collegium support): 5.0
 - 2016 (with Collegium support): 6.9
 7. The instructor encouraged student questions and participation
 - 2015 (without Collegium support): 6.2
 - 2016 (with Collegium support): 6.9
 8. The course was effectively organized
 - 2015 (without Collegium support): 5.7
 - 2016 (with Collegium support): 6.9
 9. The course developed my abilities and skills for the subject
 - 2015 (without Collegium support): 5.9
 - 2016 (with Collegium support): 6.8
 10. The course developed my ability to think critically about the subject
 - 2015 (without Collegium support): 6.0
 - 2016 (with Collegium support): 6.8

Sustainability and/or Scalability

There are enough remaining Collegium funds to run the course again during the Spring 2018 semester. Going forward, Dr. Swanson-Hysell is considering applying for departmental funds and instituting a materials fee for students who want to enroll in the course. Together, this combination of funds seems to make the project sustainable for several years into the future. Scalability appears to be limited to a maximum of 20-24 students, as the research experience requires hands-on advising and mentoring from both Dr. Swanson-Hysell and at least one graduate student. Finally, the general notion of incorporating a student-led discovery component into a course is broadly applicable.

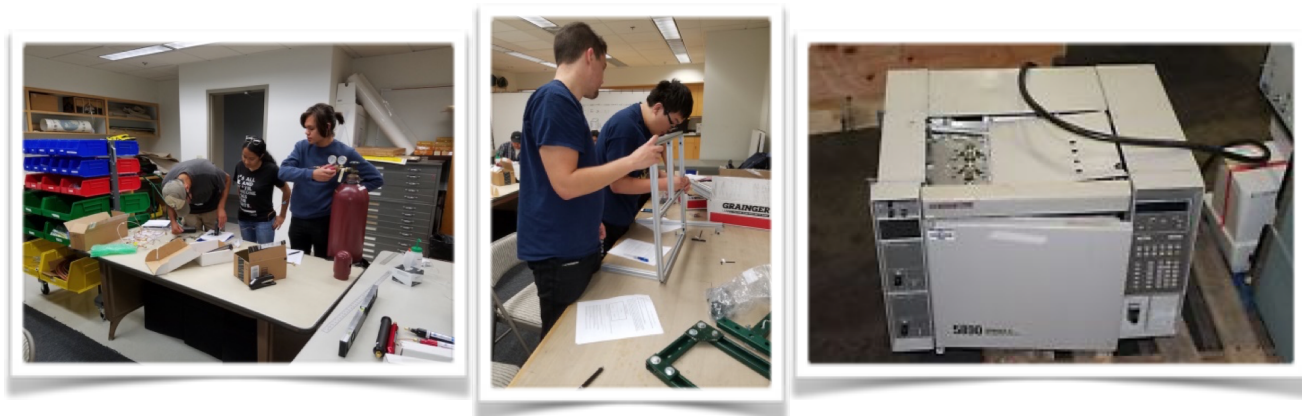
Student Feedback

- “Professor Swanson-Hysell is an engaging lecturer who is unrivaled when it comes to guiding his students in making unique field observations. He also has tremendous confidence in the abilities of his students.”
- “The format of the home works really helped us build from the ground up, our understanding of python and how to apply it.”

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- “Your enthusiasm and encouragement got me through Death Valley, and it was at that point that the lessons of this course really clicked for me.”
 - “This course provides an in-detail ability to learn how to generate a stratigraphic column. The ability to use lithology and structure to interpret depositional environment and the ability to use this data to reconstruct some earth history.”
 - “Great field course, with realistic scientific research projection and project. Good background theory in lectures and large breadth of useful geologic tools covered.”
 - “The course uses a variety of methods of learning stratigraphy and the instructor is actively engaged with the course and his students. The Death Valley field trip was amazing because many of the topics discussed in class were confirmed in the field. The trip also presented potential areas of research in terms of oncolite growth in the uppermost portion of the Beck Springs Formation, Beck Springs magnetic susceptibility, and interpretation of olistolith development.”
 - “Hands-on experience, interdisciplinary learning”
 - “Really developed my aptitude for stratigraphy in a thorough way, Prof put a lot of attention toward how to present the material best, and it showed in how much we learned. Plus, really fun class.”

GC-Maker: Building your own analyzer for environmental research

Robert Rhew (Geography)



The aim of this project was the creation of a unique, two-semester program that teaches students how to design and construct a fundamental tool in the environmental sciences—the gas chromatograph (GC). Gas chromatography is a widely used method to identify and quantify trace amounts of chemicals; it is used by researchers in academia, crime labs, drug companies and government labs. Cutting-edge technologies are often verified against the GC, given the reliability and versatility of this method. Despite the broad utility of the GC, students do not often have access to this tool. This limits what students can choose for senior thesis topics, dissertations, etc. and, more importantly, limits their ability to tackle independent research questions after completing their degree. By providing students with the guidance and knowledge to construct their own GC, this course has the potential to open many doors for Berkeley students.

During the 2015-2016 academic year, Dr. Rhew conducted a trial run of the course with just three students recruited from URAP. A full-blown course is currently underway with eleven enrolled students. The course is open to students from all levels, although most students are undergraduates. The first semester of the course covers theory, design and material choices for constructing a GC. Students start with a proposal to measure specific compounds of interest and research how those compounds can be measured by a GC. The Spring semester will be laboratory based, where teams of students will actually construct a functioning GC from “scratch”. Students will be challenged to work within a limited budget to purchase or acquire a used instrument along with the relevant components (valves, gas lines, sample loops, carrier gases, software, metering gauges and electronics) to make it work. This instrument will then ideally be used for independent research projects for the students (senior theses and Ph.D.s) with the goal of teaming up graduate students with undergraduates on related projects. A “side effect” of this project has been the creation of a “Maker Space” in McCone Hall, by converting a room used primarily for storage into a versatile workspace with tools, workbenches, lighting, and moveable tables. This space can be used for the class and broader purposes.

Learning Outcomes & Goals

- Obtain hands on, practical experience for the development and testing of an analytical chemistry instrument, the gas chromatograph
- Learn the five primary components of a GC system and how they are related to one another
- Learn to develop hypotheses to be tested using a GC
- Learn to construct a GC “from scratch”
- Empower students to realize that they can create their own workspace, help them to visualize themselves as laboratory leaders, and help them realize that developing one’s research program does not necessarily mean following a linear path

Impact on Robert Rhew

Impact on teaching:

The class I developed for the Collegium project had a large impact in helping me develop active learning techniques in my courses. This class was the MOST hands-on, active learning class I have ever done, and it gave me the practice and confidence to develop active learning lessons that I will take with me for future classes. Every week was a brand new lesson in active learning, and I think these lessons will be useful templates for other future classes.

Impact on research:

Having had to create a new maker space has made me rethink the organization in my own lab, and I’ve made numerous improvements in my own lab as a result. This class forced me to make a personal investment into learning electronics, which is useful for the laboratory. One of my own students took this class, which was a great way to help train him in a systematic way.

Course Evaluations

The pilot run of the course relied on URAP students and thus there are no formal course evaluations. See Student Feedback below for evaluative comments from students enrolled Fall 2016 semester.

Sustainability and/or Scalability

Only a small portion of the Collegium funds were used for the pilot run of this course during 2015-2016, leaving ample funds for the full-blown version of the course this year (Fall 2016-Spring 2017). Although sustainability will require another source of funding, once the Collegium funds run out, it should be noted that the maker space created by this course can be used well beyond this course and its students. Scalability is limited due to the material costs and the very intensive nature of building one’s own GC from scratch, and supervising students in doing so.

Student Feedback

- “This class by far is one of the most hands on class I've ever had (I had biology classes prior that was hands on too but less innovative and creative as this class). I look forward to this class every week as it allows everyone to participate and to learn something new each and every time.”
- "I find it inspiring and very innovative. I agree entirely with the motive and intention behind this course"
- “I really enjoy the fact that time passes really fast in this class, and that only happens when you're having fun. I believe it is very innovative because it combines technical skills with classroom skills, something which none of my classes have done in the past.”
- “...it makes me realize how much science is of a craft, and that experiments require much more than theory but practical/ physical know-how, now that I know this, from now on I will try to augment theory with experimental skills wherever possible”
- “I enjoy how we will read the background about a specific subject and immediately get to apply our new knowledge. The Make: Electronics book has also been helpful with the experiments because we first do the experiment and then learn more background and fundamentals.”
- “This class allows me to think outside the box when research money is tight. It showed me that money is limited but the human imagination and ability to adapt is unlimited when we're determined.”
- “The hands on experience is a better way to learn!”
- “...although we may be solely working on understanding how to build GCs, the principles, and techniques we are learning can be applied when we one day decide to build an apparatus of our own (perhaps from scratch).”

The UC Berkeley-Owens Valley Paiute Project: Restoring a lost cultural heritage

Patricia Steenland (College Writing Programs)



This project involved the creation of a seminar that brought together young people from the Owens Valley Paiute community with UC Berkeley undergraduates to study a body of Paiute materials housed at Cal, providing students with hands-on research experience with primary sources and community members. The seminar was conducted as a version of Dr. Steenland's course "Researching Water in the West." The class looks at the story of the Owens Valley water wars, a story famously memorialized in the movie "Chinatown." For four years, Dr. Steenland has been working with Harry Williams, an Owens Valley Paiute tribal elder to provide an essential corrective to this narrative. For hundreds, perhaps thousands of years, the Owens Valley Paiute engineered the Valley's water flow into a sophisticated system of irrigation canals. Historical documentation for this ancient system resides in the Bancroft library. Curator Theresa Salazar works with students in the class to design primary source research topics addressing this part of history widely omitted from the official record.

For the current project, the focus was on a body of Paiute materials stored in the Bancroft that reflect oral histories and stories among the Paiute people obtained by anthropologists in 1935. Some of the informants were well over 70 years old at the time. Their stories were told as a means to transmit knowledge to their youth. These stories exist in fragile notebooks at Bancroft. People in the Valley have heard of their existence, but have not read them. It is hard to overestimate the importance of these stories to the Paiute people—stories that have been lost to them due to cultural disruption and other obstacles. The major highlight of the course was a conference held in February 2016, when eight tribal members descended from the original 1935 participants came to campus to see the notebooks in person for the first time and to work with students in the course. Tribal members shared their knowledge, insight, and experience with students in small break-out sessions and round table conversations. This event, which marked the first UC Berkeley-Owens Valley Paiute gathering, not only constituted the culmination of a substantial research experience for students enrolled in the course, but also served as a moving inter-generational transmission of knowledge for the Paiute and as a way to honor Paiute ancestors' contributions to scholarship. The hope is that the seminar will be the first of a series of ongoing exchanges between the university and people of the Valley. Moreover, the course could serve as a model to other public universities in the West for creating an alliance and joint project between a public university and native peoples of its state.

Learning Outcomes & Goals

- Obtain experience working with primary sources
- Obtain community-based research experience
- Provide students with the opportunity to learn and conduct research with unusual and powerful archival materials from the descendants of the original storytellers, the members of the community from which these stories originated
- Build a bridge of trust and understanding between the university and members of the Paiute tribes and serve as a model for forging this kind of alliance between a public university and community members

Impact on Patricia Steenland

UC Berkeley's reputation as a research institution is justly renowned. But the same word, "research," can cover fundamentally different kinds of activity in any given campus classroom. It can mean first hand scientific experimentation. Or it can mean a quick Google search resulting in an assembly of already vetted information.

To teach research to undergraduates, I have explored the use of primary sources, which ask for interpretation and contextual knowledge. Working with them teaches critical thinking, patience, and diligence. Students formulate a genuinely open-ended research question, and their findings result from their sources, as opposed to having Google provide them with a set of algorithm generated sources that support a pre-selected thesis. The Collegium grant allowed me to take this work to the next level. It also generated unexpected results and discoveries for both myself and my students.

The results for students:

Introducing community partners into the classroom as the instructors (i.e., not as guest speakers) allows students to work collaboratively with them and make genuine research discoveries through means not otherwise available to them. Two examples: former student Jenna Cavelle's Stronach Research project with community partner Harry Williams on the ancient Paiute irrigation system, and last semester student Mark Johnson's work with THPO Danelle Gutierrez and the Big Pine Paiute tribe on university protocols on culturally sensitive materials.

Working first hand with community partners actively changed students' notions of research. After the UC Berkeley-Owens Valley Paiute gathering funded by the Collegium, all of my students noted that their ideas about undergraduate research had profoundly changed. One student wrote that this encounter represented a new kind of research: "Making the leap from library research to first-person interactions opens up an entirely new window into the learning process that is investigative research, rendering it more accessible. Even more impressive, such methods of gaining knowledge drastically intensify and enrich the process, thus imbuing any results of the research with a more impactful message or driving force."

The results for me, the instructor:

Working with community members regarding culturally sensitive materials as an instructor at UC Berkeley involves many issues. However, the Collegium grant opened my eyes to the discovery that

UC Berkeley undergraduates themselves can be a tremendous resource in community based research. During the gathering on campus, it was deeply moving for family members to see the handwriting of their father, grandfather, or grandmother, in fragile bluebooks on tables in conference rooms in the Bancroft library. It was a sensitive moment, as these notebooks are still in the university's possession. But students were able to make genuine connections with tribal members, showing remarkable sensitivity and understanding. I think students actually surprised themselves in this regard. Many UC Berkeley students may be one generation or closer to cultural displacement and historical trauma—experiences they often keep separate from their academic life. They were able to build a bridge to tribal members and create the possibility of collaborative work. As one student wrote, "I think this class is a fascinating case study in the effect undergraduates can have on research at universities. The undergraduate is in a unique position with regards to research because they aren't expected to produce literature, results, or data. Rather, the purpose of an undergraduate education is to gain context of the world in which we live and ignite a curiosity about a particular area of study. In this regard, we have the least propensity to come to a discussion with an agenda." I am struck by how Cal undergrads present this unusual constellation of open-ended curiosity, cultural sensitivity, and absence of a professionalized agenda. I believe it was the basis for our successful research collaboration with the tribe.

The Collegium Grant presented an opportunity to define for myself a specific model of community research. Often community research is perceived as presenting in the classroom social justice issues that ask for an activist response. For example, at a conference presentation, I was asked whether I wanted to enlist my students in a letter writing campaign to address the environmental injustices experienced by the Owens Valley Paiute. My reply was that that kind of activism is not my job---that is up to students and community members. My role as the instructor is to structure the encounter with history, using the resources of the university, especially its archives, not to outline a course of social action. The classroom is a place for knowledge and ideas. However, if students choose to pursue a course of social activism, as has happened, that is an independent activity that grows out of the classroom encounter. This opportunity to clarify my thinking has proved very useful, as I have needed to make this distinction several times since when asked about this work.

Finally, the success of this first year of the Collegium project has enabled me to continue the work of this project with tribal members. In November, I met with several Paiute Tribal Historic Preservation Officers to invite them to our next gathering in February. I faced candid questions and challenges that voiced skepticism. But tribal members who participated last year and worked with my students first-hand answered for me. It was a deeply gratifying experience.

Course Evaluations

The ratings below are based on evaluations completed by 15 of the 17 enrolled students. All ratings made on scales of 1 to 7, with higher numbers being more favorable. Means (are reported below.

1. To what extent has your instructor
- made the course interesting and useful?..... **mean = 6.0** **median = 6.0**
 - shown care and thoughtfulness in preparation of class materials and class meetings?
..... **mean = 5.9** **median = 6.0**

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- introduced you to useful research materials / strategies..... **mean = 6.5** **median = 7.0**
 - helped you prepare for future research?..... **mean = 6.2** **median = 7.0**
 - helped you with your writing?..... **mean = 5.6** **median = 6.0**
2. To what extent has your instructor been helpful
- in using assignments to develop understanding of the subject and enhance learning?
..... **mean = 6.0** **median = 6.0**
 - in encouraging student questions and participation?..... **mean = 6.5** **median = 7.0**
 - in providing opportunity for students to pursue their own area of interest?
..... **mean = 6.6** **median = 7.0**
3. How would you rate your instructor's overall effectiveness as a teacher?
..... **mean = 6.0** **median = 6.5**
4. To what extent do you think your understanding of writing and research has improved as a result of this course?..... **mean = 6.1** **median = 6.0**
5. To what extent did the library sessions enhance your understanding of the research process?
..... **mean = 5.4** **median = 5.0**
6. Please provide an overall evaluation of this course:
..... **mean = 6.2** **median = 7.0**

Sustainability and/or Scalability

There are enough remaining Collegium funds to sponsor a smaller-scale version of the Pauite-UC gathering that took place in February 2016 once again in Spring 2017. Sustainability will require additional funding sources. Scalability is limited to a seminar size.

Student Feedback

- "I think that this class is a fascinating case study in the effect undergraduates can have on research at universities. The undergraduate is in a unique position with regards to research because they aren't expected to produce literature, results, or data. Rather, the purpose of an undergraduate education is to gain context of the world in which we live and ignite a curiosity about a particular area of study. In this regard, we have the least propensity to come to a discussion with an agenda. This is invaluable in situations where the university as an institution has a tarnished reputation that it wishes to repair. By allowing undergraduates to learn from members of the tribe, we elevate the status of the individuals from the tribe from subjects of research to take knowledge from, to educators who give knowledge to a younger generation. This creates the agency to determine how the material is presented and what information is appropriate to be shared with non-members of the tribe. This is the agency that is nonexistent in the Steward ethnography, and that would have been absent if the students in our class were able to read through the notebooks ourselves. It also avoids the pitfall of thinking that cultural knowledge can exist in a vacuum, without the

geographical and cultural settings from which it arose. I believe strongly in the mission of this class and I am also thankful I have had the opportunity to come to UC Berkeley and be a part of this experience. Not only has this class impacted my understanding of the Owen's Valley and the Paiute tribe, it has made me realize the importance of culture and context in the human experience, and how to use that knowledge to better understand the practices of people around me."

- "Concerning the research aspect, I believe that last week's exchange and today's discussion regarding the use of primary sources very much illuminated the importance of engaging with the people for whom the topic you may be researching was reality. Just as using a mathematical equation without first understanding the appropriate context yield an answer of egregious error, so too is researching the culture of a living people through only books or papers bound to be a gross misrepresentation of that society. Furthermore, making the leap from library research to first-person interactions opens up an entirely new window into the learning process that is investigative research, and renders it more accessible. Even more impressive, such methods of gaining knowledge drastically intensifies and enriches the process, thus imbuing any result of the research with a more impactful message or driving force."
- "Beyond the research skills that her class made available to me, Patricia Steenland presented another gift that I will do my best to articulate here. Something about the breadth of knowledge and experience she brought to the classroom allowed her to manage 20 students from all different disciplines: environmental engineering, computer science, anthropology, etc. She created conversation that privileged no one perspective and motivated all students to offer their experience and feel accounted for in the overall curriculum of the class. The "beyond" that I mentioned that surpasses the teaching of research skills, was in Patricia Steenland's idea to bring actual community members to our classroom experience. This changed the context of my research from an interaction with lifeless text on a page to the real life personas and emotions of the people related to the issues we explored. Through this experience, I realized the thesis topic that I am very passionate about which will lead me to independent research through the Haas Scholarship and very likely into graduate school. Patricia Steenland has provided the contacts, context, and support necessary for me to conduct undergraduate research at U.C.Berkeley and for this I am ever grateful."
- "My opinion on research has changed because I have been exposed to the idea of making a personal connection with people and directly learning from them and their stories. Overall, I came out of this experience with hope and having a tremendous amount of respect for their people. There is so much we can learn from each other when there is trust and respect. Our philosophy on research must change because this kind of personal interaction has an impact on people that cannot be compared to the traditional method. There needs to be some level of respect for and knowledge of where the stories come from before we can appreciate and understand their value."
- *From member of Big Pine Pauite Tribe:* "As the Tribal Historic Preservation Officer for the Big Pine Paiute Tribe, I coordinated an eleven year project in which Big Pine tribal members transcribed thousands of pages of hand-written Paiute and Shoshone oral histories written down in 1935-1936. During the transcription project we only had PDF images of the manuscript pages rather than the originals. Pat obtained funding to make it possible for Owens Valley Paiute tribal members, most

for the first time, to see and read the original notebooks containing the oral histories of their Elders that are now curated at the Bancroft Library. The next step was to integrate this breakthrough experience with Pat's class. With the help of Theresa Salazar of the Bancroft Library, Pat arranged small group sessions in which members of her class talked with the Owens Valley Paiute participants about the stories of their Elders from eighty years ago. I was in one of the small groups and it was wonderful to see the cultural exchange between the students and the tribal members. We then participated in a class roundtable discussion in which the students expressed many heartfelt stories about their own experiences coming from different parts of the world and how they related to the conflicts expressed in some of the manuscript accounts. I felt very honored to be a participant in this gathering which took so much work for Pat to prepare. I admired Pat's perseverance, dedication, and heart in taking the time to work with the various constituents of a proposed collaborative project so that a truly collaborative project could create the basis of a great learning experience for all. I think it was a transformative experience for most, if not all involved."

PREP-IP: Research experiences for work-study engineering students in their first year at Berkeley

Oscar Dubon (Engineering)



This project sought to provide substantive research opportunities for students in the Pre-Engineering Program (PREP), Berkeley Engineering's "summer-bridge" experience for entering students who recognize that their academic preparation in high school was limited and are strongly motivated to learn skills that will make them successful students at Berkeley. During the summer before their first year, PREP students undergo an intensive academic experience that is intended to better prepare them to take their first math and physics courses at Berkeley. The focus of PREP is to give first-generation, low-income, and historically underrepresented students, among others, a leg up on course content and to instill in its participants academic confidence through improved study habits and community building with peers. While PREP students are eager to pursue research opportunities, real obstacles prevent their participation—specifically, the need to work to offset educational expenses. This project piloted an extension of PREP called PREP-IP (Industrial Practice). The idea was to extend the current PREP experience with an entirely new dimension: engineering-related work study appointments during the students' first year. These appointments were hands-on positions in research labs across campus and in the community.

PREP-IP was brought to life during the 2015-2016 academic year, involving the placement of 14 students (all of color) in 2-5 hours/week work-study appointments. Students chronicled their efforts and experiences through their appointments, and obtained one-on-one mentoring from Dr. Catherine Newman, a graduate of Cal's engineering Ph.D. program and primary point person for this project. Throughout the year, students also met with professors, professionals, and graduate students to discuss career options (e.g., LBNL, Google, MIT, Pandora, Disney, Georgia Tech), and all participating students applied for multiple summer internship or research opportunities. The work-study appointments were wide-ranging, including, College of Chemistry, Lawrence Berkeley National Lab, and BART. Dr. Newman has continued the program this year in scaled back form (due to limited funds) with workshops and more group-based mentoring and guidance in obtaining work-study appointments that provide research opportunities.

Learning Outcomes & Goals

- Provide PREP participants with engineering-related work study appointments during the students' first year
- Obtain hands-on positions in research labs across campus and in the community that would help students tackle college expenses while preparing them in a targeted fashion for advanced summer research opportunities and internships
- Build classroom knowledge into practice and obtain exposure to much needed opportunities to build the sort of confidence and expertise gained only through a hand-on experience

Impact on Catherine Newman

The most significant personal outcome I received from this award was confidence in my belief that there were rewarding practical learning opportunities for engineering students outside of the classroom. Opportunities that will in fact help them to become working engineers, while also complementing and fitting contextually alongside a demanding curriculum. I wanted to design a program that helped students personally identify what aspects of engineering they were interested in and how they liked to work (in teams, on one project at a time, with their hands, on theory, on research, etc), particularly first-to-college students, who may not realize that there are many ways to be an engineer or that they, even now, have agency in that process. Engineering on their own terms, so to speak.

Course Evaluations

The PREP-IP program did not involve a course, so there are no formal course evaluations. See Comments and Testimonials below for evaluative comments from 2015-2016 PREP-IP participants.

Sustainability and/or Scalability

Nearly all of the Collegium funds were needed to support the 2015-2016 implementation of PREP-IP. However, in this initial run of the program, students were given considerable one-on-one mentoring to obtain work-study appointments and navigate the semester in these appointments. The costs of re-running the program could be cut considerably by running a version wherein students are mentored in group-based settings. Group-based workshops are currently be conducted in this vein. In addition, the establishment of work-study appointments in the first year of PREP-IP in various on- and off-campus lab, organizations, and entities will likely pave the way for opportunities at these same locations for future PREP students.

Student Feedback

- “This semester has been going great! I wanted to thank you for connecting me with Professor Ostertag’s lab. It has been an incredible learning experience. I am able to see first-hand how the

topics in the courses I'm currently taking are applied into research. I've gotten the opportunity to be a research assistant on a project that deals with reinforced concrete columns. This has helped spark a greater interest in the structural aspect of Civil Engineering. I am also in the preliminary steps of beginning my own project centered on the topic of corrosion measurements of reinforced concrete. Let me know if there is any way I can help or give back to PREP-IP."

- "I wanted to thank you for letting me be part of the PREP-IP. I believe this program helped me land my first internship this summer. It provided me with the opportunity to get experience at the Lawrence Lab which was my first technical job and which gave me things to talk about during my interviews. PREP-IP helped me decide what I wanted to do after college. I was able to experience what research looks like and it helped me realize that research was not for me but that I really enjoyed working in teams, and not by myself. I think it's a great program for students who don't know what a job in their field looks like and want to gain more experience and exposure."
- "Something new and exciting was that Prep-IP made me realize how much I like computer science and engineering that it motivated me to go to Graduate School. I think that it was helpful because it pushed me to get out there and look for opportunities although it was not necessarily in my field. Your support with my academics and the support of the program helped me grow as an engineer."
- "PREP-IP reinforced what I wanted to do in the future. I enjoyed working hands-on in lab and soldering parts. It was cool seeing all the parts I worked on during the year fit into the nodes they were building. I've always enjoyed the physical aspects of engineering and seeing the process in the lab was neat, even though sometimes I didn't know what parts were."
- "I just recently got an internship working for Traffic Patterns, so I have been looking at traffic control procedures. PREP-IP guided me down this path. I was able to gain exposure from working at BART and determine what else I would like to explore. PREP-IP introduced me to new ideas and programs, by placing me around a lot of accomplished people. I was also put in an article for BART: <https://www.bart.gov/news/articles/2016/news20160901>

Reflections on the Grants Program

Broad Themes

In monitoring the progress of our first cohort of grant recipients, and from direct conversations with each awardee, we have distilled a number of broad themes that cut across two or more of the projects in this first cohort.

1. There is a multitude of ways that one can bridge the gap between teaching and research (each project addressed this aim, but in entirely different ways)
2. New research opportunities can be readily incorporated into existing programs and courses (e.g., PREP-IP built on PREP)
3. Research experiences can effectively serve as the core of a given course (e.g., Death Valley field trip) without compromising the breadth of what is learned in the course
4. Students believe that undergraduate education at Cal should involve more than what is in textbooks, articles, etc. written by others; hands-on research and related discovery experiences are indispensable to a Cal education
5. Getting undergraduates involved in research experiences like the ones offered by these funded projects help both undergraduates and faculty realize that undergraduates matter—they can contribute directly and substantively to research, and to communities and society through their research efforts
6. Students desire and respond with great enthusiasm to “real” research experience (beyond the show-and-tell model); they are eager to be given meaningful research roles and to engage in meaningful activities
7. Shared discovery (e.g., reading the Pauite primary resources for the first time; articulating and testing novel hypotheses in Death Valley; building a GC from scratch) is an exciting activity for instructors and students alike
8. Thrust of this grants program coheres tightly with core elements of the Undergraduate Initiative, including nearly all of the core competencies (e.g., numerate, creative, investigative) and dispositions (e.g., open-mindedness, disciplined) that documents outlining the UG Initiative have specified

Impact on Students and Awardees

We the Collegium members, at times in conversation with the awardees, have reflected deeply on the impact our funded projects have had on students, awardees themselves, and beyond. One key conclusion we have come to is that “impact” can take many forms: it can be direct or indirect, immediate or longer-term, viewed in quantitative terms or more qualitatively, and so forth. We have revealed and articulated many of these impacts in the sections above, in part by providing direct accounts from students and awardees themselves about the impact the projects have had on them. Here we highlight some of the less obvious, but equally if not more powerful, impacts we have discerned from our analysis of the projects.

- Motivates faculty to think more about the role of research in their teaching

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- Serves as a model for other faculty to engage in efforts to bridge the gap between teaching and research
 - Encourages the creation of infrastructure that can facilitate future efforts to bridge the gap between teaching and research
 - Opens doors and reveals avenues for undergraduates in terms of graduate and/or future career plans
 - Empowers undergraduates, gives them agency and ownership of their learning and discovery experiences
 - Can provide concrete pathways to increase the involvement of specific groups of students in the research enterprise

Looking Ahead: What We, the Collegium Have Learned

As of the writing of this document, we have added another cohort of grant recipients (2016-2018), bringing the total number of grant recipients to eight (four in each of the two cohorts). Because this grants program is still in its infancy, we are still in the process of learning how best to run the program, ranging from administrative and logistical details to selection criteria and assessment procedures.

Based on our observations and analyses thus far, here are some of the changes and improvements we will implement in the next grant cycle:

- Have applicants articulate concrete learning aims and outcomes a priori
- Improve selection criteria, including scalability, sustainability, and effective use of funds as important evaluative dimensions
- Be explicit and detailed upfront with applicants about the kinds of assessment that we will undertake throughout the grant period
- Obtain pre- and post-measures of learning outcomes, as appropriate
- Obtain feedback directly from students on the impact of the projects
- Ask applicants and students how the project affects students' experience with their particular major
- Develop a working list of suggestions on how to broaden the impact of the projects we have funded, as they may be a driving force for broader impact in subsequent projects
- Undertake a comparison of the grant recipients to evaluate what may be core features of successful classes and projects that narrow the gap between teaching and research