

Application: 33389 | General

SCENIC 2023: Southwestern Colorado Expansion and Multilingual Support

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Page: Project Title
Project Title SCENIC 2023: Southwestern Colorado Expansion and Multilingual Support
Page: Contact Information
Has this project been funded in the past with a CU Boulder Outreach Award? Yes
Have any of the primary faculty applicants received a CU Boulder Outreach Award in the past? Yes
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Other Essential Personnel

Essential Personnel

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Page: Proposal Narrative**Demonstrated Need**

The proposed project, builds upon the Science-Engineering Inquiry Collaborative in Rural Colorado (SCENIC), expanding a developing partnership between CU's College of Engineering and Applied Science and School of Education, regional university partners in Colorado, and rural middle and high schools in Colorado. The project enriches engineering and science education opportunities in underserved rural K-12 schools who struggle to attract science teachers and have very little engineering education available. Project need is reflected in teacher and superintendent assessments from partner schools who seek additional support for highly engaging inquiry-based instruction at the intersection of engineering and science, and the further development of an academic pathway from their school districts to higher education with possible enrollment at CU or partnering nearby regional colleges. Funding will expand the efforts to include other areas and partners in Colorado and add Spanish translations of the curriculum.

There is also a need for CU engineering students to have experiences teaching and mentoring in K-12 settings. Engineering students report building communication and teaching skills that are key outcomes for engineering graduates. In addition, K-12 school teachers report that CU engineering students are good role models for K-12 students and encourage them to consider college in an environment where 48% would be the first generation in their family to attend college.

An outreach award would also provide bridge funding as we have submitted a proposal to the National Science Foundation that is currently under review by NSF's Division of Engineering Education and Centers.

Project Goals

In our vision, CU faculty and students work with rural schools on educationally impactful student driven inquiry projects at the intersection of engineering and science, in environmental monitoring. Project goals are: (1) prepare cutting-edge environmental engineering tools applied to science inquiry for K-12 classrooms, (2) deploy CU student mentors to support K-12 teachers and students in implementing project-based learning based on these tools, (3) expand collaboration between CU's CEAS and Education, regional universities, and rural public schools to develop, research, and evaluate the initiative.

Objectives for Goal 1 include development and deployment of CU-developed air and soil quality monitors for integration into K-12 science courses. Objectives for Goal 2 include preparing CU mentors in an engineering two-semester course, developing new K-12 curriculum in Spanish, and sending CU students to support K-12 classes remotely or in-person. SCENIC 2023 will offer expanded remote learning activities to better support student projects and build upon these beyond the pandemic. Objectives for Goal 3 include holding teacher workshops either in-district or remotely, and continuing research and program evaluation to inform refined design of educational resources. This project aligns with CU's three campus strategic imperatives: 1) CU students serving as role models in Colorado rural schools aligns with shaping tomorrow's leaders; 2) developing and adapting new educational curriculum and tools for enhancing science and engineering education aligns with being the top university for innovation; 3) bringing CU faculty, students, and innovative tools into underserved rural Colorado K-12 classrooms positively impacts humanity.

Project Plans and Timeline

This project will span the 2023-2024 academic year. Goal 1, Prepare Engineering Tools, will be accomplished by servicing and redesign of air quality and soil quality monitors (Pods) for delivery to high school classrooms in November and supporting the Pods so that they function and collect data reliably.

For Goal 2, Classroom Support, CU mentors will be trained in fall to use the Pods in the engineering course, Project Based Learning in Rural Schools, and deployed with the Pods for initial November remote or in-person visits. Mentors will assist high school teams with air quality inquiry projects with monthly visits in Spring 2024 coupled with remote learning opportunities and symposium presentation support. High schools students will present research posters on their projects at symposiums in their districts in March/April.

For Goal 3, Development, Research and Evaluation, teacher workshops will be conducted early in the fall. Pre-assessments will be conducted in the fall and post- assessments after the spring science symposiums; observations will be conducted in select classes and at the symposiums, and interviews of participating teachers and selected students will take place after symposiums in person or remotely as needed.

Diversity, Equity, Inclusion, Accessibility Objectives and Goals

In alignment with the CU Boulder Diversity Plan, the overall SCENIC program framework and the proposed SQUI project is specifically designed to be inclusive of a very underserved rural, 40% first generation Colorado population with a significant Latinx minority (~33%). The K-12 participants are majority female (~60%) through association with many AP environmental science classes that enroll a larger number of girls than boys. The inquiry based curriculum also encourages inclusive projects by allowing partner students to choose their own environmental project in an area of personal interest rather than assigned project topics which may not resonate with individual student backgrounds. Integrating a rural, first generation population into higher education is important for increasing career prospects of a large group of Coloradans who typically have few resources to provide cutting edge engineering tools for their students.

At CU, the mechanical engineering class, Project Based Learning in Rural Schools, has a focus on learning how to conduct K-12 outreach in rural settings with a large population of partner K-12 students who have rarely visited the CU campus or Boulder. In particular, the course exposes a number of CU students from an urban background, other states and countries to issues prevalent in rural Colorado. The course also enrolls a larger percentage of women (~50%) than the College of Engineering and Applied Science as a whole (~30%). The course is also open to all CU students and enrolled its first students in 23-24 from CU's partner engineering program with Western Colorado University.

Faculty Member Roles

Daniel Knight is an associate research professor in the Department of Mechanical Engineering in CEAS. He has a Ph.D. in engineering education and 22 years experience as education research faculty in the College. Daniel is funded by the

Department as lead teacher for the CU course, Project Based Learning in Rural Schools. Daniel would serve as Education and Outreach Director for the SQUI project, co-teaching the course with Mike Hannigan, leading the implementation of the curriculum and traveling to partner school districts and colleges with CU students to facilitate partner projects and relationships. He will also take the lead on partnering with CU School of Education faculty and students to incorporate research/evaluation results into SQUI.

Mike Hannigan is professor/Chair of the Department of Mechanical Engineering in CEAS. Mike is the Science and Engineering Director of the project and Director of the Hannigan Laboratory that is developing the environmental monitors (Pods) for the initiative. Mike and the lab will build and maintain the -Pods for partner schools. He also co-teaches the PBL in Rural Schools Course and will integrate environmental science and monitoring into the course. Mike is overseeing content development for the curriculum as well, with a long term focus on building an undergraduate environmental engineering outreach inquiry based curriculum focused on air quality (AQIQ), soil quality (SQIQ) and water quality.

Joe Polman is professor and Associate Dean for Research in the School of Education. Joe has a PhD in the Learning Sciences and 25+ years experience developing and researching project-based learning. Joe would oversee education research and evaluation for the project. He will supervise a doctoral student evaluating and researching the experience of K-12 and CU students in the program.

External Partner Role

Proposed partners for the project are expected to be 13 K-12 schools in 10 districts: Delta County, Weld County 6, Lone Star 101, Mesa County Valley 51, Fort Morgan School District RE-3, Mountain Valley School District RE-1, Archuleta School District #50 JT, Ouray School District R-1, St. Vrain Valley Schools District, and Pueblo School District 60 (new in 2023)

Partner students and teachers answer local science and engineering inquiry questions about environmental issues. The project builds interest in college among K-12 students and families in a population where 48% would be first generation, by exposing them to higher education institutions and students, and engineering content.

The program includes partnerships with regional universities closer to the targeted rural school districts. Colorado Mesa University and Western Colorado University (who partners with CU in mechanical engineering) will send faculty to be symposium judges and offer tours to K-12 students. Ft. Lewis College is considering a similar plan.

For CU, this is an opportunity for faculty research to assist underserved, rural Colorado school districts and partner with regional universities in Colorado. Faculty and students from CU's College of Engineering and Applied Science and School of Education benefit from mutual collaboration as well. CU student mentors have the opportunity to develop communication, teamwork and applied science skills appropriate for engineering graduates. CU engineering students should also learn the value of working with K-12 communities after graduation. CU education and engineering graduate students involved in curriculum development, evaluation, and research learn important engaged research skills.

Audience served

The non-CU Boulder audience includes rural community members and 48% first-generation students in Colorado. Local community partners have emerged such as farmers, ranchers, local businesses and coal miners and government agencies such as the Bureau of Land Management and environmental organizations such as the Western Slope Conservation Center in Paonia, CO. These community members interact with students to develop inquiry based projects and provide opportunities for data collection in their facilities and locations.

These community members work with students and teachers in the School Districts. Projects often start in the district with a connection made with a K-12 teacher who has been referred by another teacher or someone at a CU Office. Previous assessment results indicate a population underserved in engineering with ~60% female participants, ~33% who are Hispanic, and ~48% who would be the first generation in their families to attend college. The program will work with a variety of high schools including Delta, Northfork (Hotchkiss), Fruita Monument, Palisade, Ouray, Pagosa Springs, Mountain Valley (Saguache), Greeley West, Niwot, Fort Morgan and Lone Star (Yuma). A new school will be added and a new regional university partner in Fort Lewis College in Durango.

Student Involvement (if applicable)

CU Boulder students will be central to the development and implementation of the SQIQ project. The engineering mentoring course serves as a base of operations for weekly student training on inquiry based project mentoring and use of engineering technology in the classroom. CU student mentors will begin traveling regularly to high school classrooms in November to implement an engineering and science curriculum and are expected to spend four days in the classroom the week prior to the start of the spring 2023 semester.

CU students will also be in touch with their teams via phone and other remote media (e.g., Zoom) to mentor student teams by providing guidance on project development, interpretation of research results, and communication of results at the Engineering and Science Symposiums. CU students will also judge other student teams at the spring symposiums and serve as tour guides for symposium winners who want to visit CU. The proposed program will also employ a CU engineering student as course TA, along with a student team from the Hannigan Lab for monitor development and a CU Education graduate student to support education research and evaluation. Traditionally, the CU engineering student TA is a former mentor and will benefit from the added responsibility of coordinating mentors, grading assignments and supporting K- 12 schools at a higher level. The education graduate student will be experienced in project-based learning and mixed research methods applicable to the project, and this project will contribute to their ongoing development as a researcher

Contingency Plan

Running a rural outreach project during the winter in Colorado has necessitated contingency planning from the start of the program. Challenging terrain and unpredictable weather often separate CU Boulder from partners on the Western Slope and high plains. CU mentor teams have moved to remote learning and rescheduled travel dates many times in the past eight years. CU students who take the class are tech savvy and have worked with K-12 partners on Zoom and Google Meets platforms for classroom teaching and after school office hours. These experiences have set the program up well for adaptation to Covid19.

In the 2020-2021, CU mentors taught the entire program remotely with all lessons completed and remote symposiums held for all schools to present their projects. In 2021-2022, student mentors and partner schools transitioned between remote and in-person learning and adjusted their teaching plans accordingly. During these periods, CU mentors have incorporated engaging software into their remote teaching such as Kahoot and Jamboard which facilitate the sharing of ideas and knowledge. Moving forward, the program will continue to adjust both remote and in-person opportunities as needed. The budget has been adequate to meet the needs of these transitions and any changes are addressed in cooperation with the Office for Outreach and Engagement.

Collaborative Efforts

The proposed project will mutually benefit the College of Engineering and Applied Science (CEAS) and the School of Education (SOE). Both units will benefit from opportunities for interdisciplinary collaboration among faculty and students.

For the College of Engineering and Applied Science (CEAS), a benefit will be application of education research and evaluation practices for SCENIC program improvement and for understanding the impact of participation in outreach programs on participants—engineering students and K- 12 students. Formative evaluation will inform ongoing program implementation and summative evaluation and research will inform the next program offering as well as the relevant engineering education research literature.

For the School of Education (SOE), a benefit is expansion of research contexts in rural Colorado, including in the geographic region of Northeast Colorado, which is targeted in a School-wide place-based partnership program. SOE participants will also benefit by continuing a long-standing program of research on project-based learning and identity development in the new arena of inquiry spanning engineering and science, in understudied and underserved rural contexts. SOE researchers will also benefit from the subject-matter and technical expertise of Engineering partners. A doctoral student's development as a researcher and evaluator will be enhanced by participation as a graduate research assistant

Continuing or Previously Funded Applicants (if applicable)

The project is in its eighth year, first under an NSF Sustainability Research Network award and then under a Campus Outreach Award for the past six years. At CU, the mentoring program has steadily drawn a larger percentage of women (~50%) than are in the overall CEAS population (~30%) At the K- 12 level, the project has grown steadily by impacting 40 students at one high school in its first year and growing in its seventh year to impact 12 schools in the northeastern and southwestern portions of rural Colorado and over 300 students in the current year with 25 mentors in the field from CU Boulder, Colorado Mesa University, and Western Colorado University. To date, the project has worked with 13 K- 12 schools, 3024 middle and high school students, 99 CU student mentors, and 11 CU Faculty. Project participants have included a large number of Latinx (~30%) and female (~60%) K- 12 students, and a large population of students who would be the first generations in their families to attend college (~40%). The project has engaged numerous rural community members through inquiry based projects in partnership with local business and government organizations. Annual symposiums at partner high schools also provide an opportunity for various community members to get together to see student posters including local project sponsors, politicians, parents, siblings and members of local community groups. The Outreach award funding will allow for development of the project as it expands under the SCENIC program and seeks permanent funding.

Page: Assessment/Evaluation Impact

Assessment/ Evaluation Plans

Data sources for evaluation and research will include the following. An online focus group will be conducted with past and new teachers in the fall, to inform ideas for the development of program supports as well as potential future research foci. Pre- assessment surveys of participating undergraduates and high school students will be conducted in the fall and post- assessments in the spring after the science symposiums. Observations by the Education graduate research assistant will be conducted in select classes on campus and at the K- 12 schools, and at the symposiums. Interviews of participating teachers and selected students will take place after the symposiums. The content of these research instruments will be informed by a combination of the prior work on the project, the relevant literature on project- based learning and identity development in science and engineering, and the prior research by Polman and his students in this area. The pre- assessment and interim classroom observations will be used to formatively improve the guidance being provided to undergraduate mentors and to high school students. Analyses of all the data will be transferred into an assessment report and debriefed with SCENIC program faculty to inform redesign of tools, curricula, and procedures for future initiatives and serve as pilot results in applications for external funding (to the National Science Foundation).

Provide a breakdown of the estimated number of those who will be involved and directly affected by the project. (Note: This is not to suggest that more is better; the committee understands that some outreach work may go deeper but serve fewer people.)

CU Boulder Faculty

12

CU Boulder Staff

2

CU Boulder Graduate Students

15

CU Boulder Undergraduate Students

28

External Constituents

1373

Page: Budget Information

Budget Narrative

The requested budget would support SCENIC travel, supplies for environmental engineering monitors, expenses for science symposiums in partner school districts, CEAS support for monitor development, and GRA support for a School of Education graduate student.

For SCENIC travel, \$4,213 is requested for transportation for students and faculty to partner school districts. This will cover car rental, fuel, allowable per diem and accommodations for monthly school visits.

For engineering environmental monitor development, a budget of \$2,305 is requested for supplies for the development of environmental monitors. Development is expected to capitalize on existing outreach monitoring tools in engineering.

For the CEAS, a budget of \$2,236 is requested to hire one student hourly to support development of a Spanish translation for aspects of the curriculum.

A budget of \$2,991 is requested to host science symposiums for printing of posters and purchase of food for symposium participants throughout March and April 2024.

For the School of Education costs covering SCENIC program evaluation and education research, a budget is requested for a graduate student, with \$10,438 requested for support of student tuition, stipend expenses and fees.

A total of \$1,817 is requested for GAIR

Funding requested: Total dollar amount of funding requested from the Outreach Committee, \$24,000

Funding Requested

24000.00

Provide a breakdown of the project budget.

Chair/Director Endorsement Letter #3

No File Uploaded

If you were awarded outreach funds in the past, you are required to submit a Final/Status Report, even if you have not yet completed the current project.

Only applies if continuing the same outreach award project or are building on previous work for a new project. A final/status report needs to be submitted even if the continuing project has new faculty applicants.

You do not need to submit a report if the project was funded with a community impact grant or micro grant received from the Office for Outreach Engagement.

The final report form can be downloaded from the Office for Outreach and Engagement website (<https://www.colorado.edu/outreach/oe/outreach-awards/faculty-group-application-process>).

Final/Status Report

Download File (https://cuboulderoutreach-engage.secure-platform.com/file/40332/eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJtZWRpYUlkIjo0MDMzMiwiaWYwxs3dOb3RTaWduZWRVcmwiOiJGYWxzZSI6ImInbn9fy22-23_final-report-SQIQ.pdf)