# Research Opportunities for Science Educators (ROSE)

Pilot Program Report

Part B. Assessment

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**Executive Summary**

The ROSE (Research Opportunities for Science Educators) pilot program at UNM in the summer of 2021 demonstrated the need for and viability of the underlying concept: participating in university research projects is both attractive and beneficial to high school science teachers. In spite of the last-minute organization and recruiting for the project, nearly forty teachers applied for only eight Scholar positions, and all of the Scholars found the experience valuable and expressed interest in returning for another summer. The Scholars and their PI mentors all contributed ideas for improving the program in subsequent years.

Scholars and mentors found the ROSE program "overwhelmingly valuable, worthwhile, and well-organized" (Program assessor A. Stewart). While professional development opportunities typically focus on pedagogy, the research experience provided a unique opportunity for development in subject matter mastery and helped to renew confidence and enthusiasm: One Scholar noted that "*I really like to keep developing my teaching and… reinvigorate the love for that science as well… it's a nice thing to just get that love back, and remember why… I love the chemistry…".* Scholars acquired specific skills and tools to bring back to their classes in the Fall—notably, the use of the UCSF Chimera molecular modelling software and experience with Python—but also new ways of explaining and motivating students: *"…some of the ways that the professor teaches with motion was just really great. And it was really effective and I had never really thought of doing that. And when I did that in class—I actually did something kind of like this in class—and it really was an effective way of doing it and explaining something."* The pilot program also familiarized the Scholars with the Albuquerque campus and facilities and made them more inclined to encourage students to attend UNM.

Based on the suggestions of the participants, including PI mentors and Scholars, the organizers hope to expand and improve the Program in coming years. Expansion to a larger cohort of Scholars would occur in stages, beginning with the current focus on chemistry teachers but including PI mentors from other departments who use chemistry to address research problems in related areas such as engineering, physics, biology, and the biomedical sciences. The recruiting process should begin with publicity in January, teacher applications due in March and completion of the selection process in April. The Program should consider a longer research period of 5-6 weeks, rather than the 4 weeks of the pilot program. More informal cohort-building activities could include housing out-of-town Scholars on the UNM campus and scheduled weekend social activities. More formal activities could include scheduled mentor-Scholar communications before and after the research period, organized presentations and tours on campus, and panels/discussions on science teaching and 'taking it back to the classroom'.

## Goals of assessment

The ROSE program aims to improve science education in New Mexico by updating and enhancing the training and background of science teachers through participation in funded research projects. New Mexico schools lag behind those in other states by many educational metrics, including graduation rates and scores on science tests. More specifically, under-represented minority (URM) students were found to be at a significant educational disadvantage in the Yazzie-Martinez decision, while all New Mexico students pass the Chemistry Advanced Placement (AP) test at a much lower rate than the Biology and Physics AP tests. ROSE is based on the concept of helping students by improving the scientific knowledge, self-confidence and enthusiasm of their science teachers. ROSE recruits teachers of chemistry and related science courses from schools with significant URM student populations into university research projects, where they can update their science background, learn new skills and new approaches to science, and rediscover the excitement of scientific research.

The pilot program of Summer 2021 was intended to explore the viability of the ROSE concept and the practical mechanics of an on-campus research experience for teachers from across the state. Support from NM PED and UNM VPR allowed a small cohort of 8 science teachers (ROSE Scholars) to participate in research projects in the Department of Chemistry and Chemical Biology (CCB), as described in Part A of this report.

The pilot program assessment was intended to explore:

a) The viability of the general concept: Are NM science teachers interested in and able to benefit from a research experience? Do the benefits translate into changes in teaching and classroom behavior?

b) Are the logistics of Scholar recruitment, selection, support and introduction to research feasible? What are significant costs and requirements?

c) Does the ROSE experience change teacher attitudes toward their subject? To UNM? To faculty mentors and the Department?

d) How can the program be improved going forward?

## Assessment Plans and Timeline

Since the ROSE organizers from CCB are not trained in social science or educational research methods, the Program recruited a professional social scientist and researcher, Prof. Abigail Stewart, to perform assessments. Prof. Stewart is currently consulting for ADVANCE at UNM (an NSF-funded center for women and minority STEM faculty).

Abigail Stewart is the Sandra Schwarz Tangri Distinguished University Professor of Psychology and Women's Studies at the University of Michigan (UM). She has published over 200 academic articles on psychology, gender and academic institutions, including the 2017 book The inclusive academy: Achieving diversity and excellence coauthored by V. Valian and published by MIT press. She has served as Associate Dean and Center Director at UM, and from 2001-2016 directed the UM ADVANCE Program for women and minority STEM faculty.

Given the limited number of Scholars (8) and PIs (5) participating in the pilot program, quantitative surveys would be unlikely to produce useable data. Prof. Stewart and the organizers decided upon a qualitative, interview-based post-Program assessment. The team decided on

three sets of interviews, one with the UNM faculty PI mentors and two with the ROSE Scholars; the first round of Scholar interviews was conducted shortly after the pilot finished (so that the experience would be "fresh" in memory), and the second round was conducted two months later during the Fall semester, so that Scholars had more time to process the experience and let it influence their classroom teaching. The organizers discussed the information desired from the interviews and presented brief documents to Prof. Stewart, who transformed them into interview scripts. Dr. Stewart conducted the interviews, recording and transcribing responses, and wrote a report on each set of interviews, contained in Appendices B, C and D.

**Mentor/PI Interviews**

A review of the Mentor/PI interviews reveals uniform approval of the Program. All mentors found it valuable to their research programs, and many commented that the experience helped them hone their mentoring skills. To quote Prof. Stewart,

> ***"All of them hope to work with the program in the future, all have continuing contact with their Scholar mentees, and all pointed to gains for them and for the Scholars, as well as for the department and UNM, from the ROSE Scholars Program."*** *From Appendix B*

Many felt that the Program could benefit from being one or two weeks longer. There was unanimous support for the weekly Friday lunches, but many felt the entire experience could be made more valuable by including additional structure such as topics for discussion, as well as creating field trips to local museums for the Scholars on the weekends. It was felt that these activities would allow the ROSE Scholars to form more meaningful connections with their peers, and enable them to learn more about Albuquerque, potentially improving undergraduate recruitment efforts. The mentors felt strongly that future versions of the Program should include financial support for those graduate students that are significantly involved in Scholar training. All mentors have maintained contact with their ROSE Scholars, indicating that the creation of community focused on chemistry education instruction has been successful thus far. Lastly, all PIs felt that the Program helped to reveal to the Scholars the nature of research, but it also unexpectedly uncovered the many challenges the Scholars experience as high school teachers.

**Scholar Interviews**

The feedback from the Scholar interviews was that the 2021 pilot program was "overwhelmingly valuable, worthwhile, and well-organized," with only minor modifications recommended for the Program in 2022. All eight of the 2021 participants would like to participate again. Many of the consensus suggestions of the Scholars can be implemented with the longer timeline available to a regular, rather than pilot, Program; these are included below in the Considerations and Suggestions section. Examples include advertising and recruiting earlier in the calendar year; considering expanding the length of the Program from 4 to 5-6 weeks; additional mechanisms for advertising the Program; arranging for housing as a cohort, on campus; and providing pre-Program briefings on research projects and the way that the Program will be structured—i.e., a more comprehensive setting of expectations.

The motivations of the Scholars in deciding to apply to the Program highlighted their excitement about the opportunity to do (real) research:

***"It was a very unique opportunity that I hadn't seen for 20 years—to be able to go into a research lab and [I] don't have to worry about anything else."***

***"I really like to keep developing my teaching and… reinvigorate the love for that science as well… it's a nice thing to just get that love back, and remember why… I love the chemistry…"***

***"I really want to experience firsthand… real research… working with experts in their field… [where] we're not just going to be observing… [but] are actually part of the research process."***

There were some unexpected (and thus especially valuable) comments that emerged from the interviews. A common theme related to structure—at both the research group and cohort levels. Some Scholars felt that the group activities could have been more structured, "to ensure full participation and equity" and enable greater intra-cohort communication, relationship-building, and the sharing of newly-gained expertise (notably computational tools and visualization software) to take back to their classrooms and enhance their teaching. One suggestion for facilitating cross-fertilization of ideas, and greater interaction within the cohort, was to establish a shared, dedicated space for members of the cohort, in addition to office space within each individual lab. Group lunches coordinated by the Program, and individual research group lunches, were all highly appreciated.

Several Scholars expressed surprise at encountering the largely unstructured nature of research. Although they had enthusiastically taken the leap to apply to the Program, some Scholars were anxious about whether they had the necessary background ("rusty", "intimidated", "out of comfort zone") to participate effectively. One Scholar suggested that the Program might want to "stress to applicants that it's okay if they have no past experience." There was some culture shock associated with transitioning out of the highly structured environment of high school classes ("bells ringing", "very rigid schedule") to the more fluid lab/research environment where the PI is not present all of the time, and researchers are expected to be strongly self-motivated and able to work independently. On the other hand, Scholars also "appreciated that there was time to reflect, consolidate and relax, particularly because their time was not too structured." These expectations about structure could be addressed by setting more specific goals and expectations in advance of the Scholars' arrivals on campus, providing a fact sheet on logistics and expectations, and by describing the unique environment of a research lab as part of the ROSE Program announcement.

All of the Scholars experienced a "powerful" and "substantial" impact from the Program—new ideas, experiences, renewed passion for science, strategies for teaching complex concepts to their students, integration of knowledge, and new ideas for incorporating that knowledge into their pedagogy:

***"I'm just jazzed to tell [my peers]… about the research… it was such a great experience to see how the applied lab techniques, the instrumentation… what kind of things we should probably think about covering more… how does this tie to what we're working on [in high school]."***

***"The really exciting thing for me was… being part of something bigger and really getting the opportunity to learn… about what's happening in research and in the field of chemistry…"***

***"Even just being able to get in the labs gives you that confidence back in your content area."***

***"In general ways I have brought into science class a deeper perspective on how scientists operate, how they use evidence to support their claims."***

***"Everything seems to connect at the quantum level: biology, physics, and chemistry…"***

***"The interdisciplinary application of chemistry and physics and statistics…"***

***"I realized I could pull a lot of these organic terms into my class, and that would probably make [my students]… feel a lot less overwhelmed when they get in college later on… this is what's at the forefront [and].... try to get them excited about that."***

***"This experience got me to reflect: is what I am doing relevant to what's happening out there? Am I building that connection that's really making an impact on our students… Right now I'm thinking about how to introduce some of the concepts that I learned over the summer… [to] make sure that [my labs are]… relevant to current research and try to actually let [my students]… have life experience to get as passionate as I was…"***

***"It's like the ultimate professional development training for me… [that I] can share to my colleagues [at]… my school and to the district. Number one is the practice of research itself."***

***"I didn't know computation was out there… I'm a hands-on kind of person. Talking to [peers doing computation] I saw the importance of that as well."***

***"The use of different equipment, and the instrumentation will be the highlight of my presentation [to my students]… my students can see that research is fun. And I think that's what's lacking in our school today… and there is diversity… My goal is to inspire [my students] to pursue their dreams to… pursue [a] STEM career."***

***"The opportunity to be in a research lab that's during [sic] groundbreaking current research. The hands-on opportunity is invaluable… not just to read about it, but to be a part of it. That's amazing!"***

The second round of interviews in October reinforced the earlier positive assessments of the Program, with Scholars also able to comment on how their teaching was impacted by the summer experience. Specific changes were noted in lab exercise design, answering questions from students, and new ways to explain chemistry material.

***"In general ways I have brought into science class a deeper perspective on how scientists operate, how they use evidence to support their claims. I can talk more about what scientific research is like and how it works."***

***"…now I have a better way of giving these kids a visualization of a protein or an enzyme which is a protein."***

***"…some of the ways that the professor teaches with motion was just really great. And it was really effective and I had never really thought of doing that. And when I did that in class--I actually did something kind of like this in class--and it really was an effective way of doing it and explaining something."***

The Scholars remain interested in returning to research next summer, and several have recommended the ROSE Program to their teaching colleagues. As noted by Prof. Stewart,

***"Overall, it was clear that the ROSE Scholars used their summer experience to deepen, reinvigorate and enrich the way they thought about both their pedagogy and the content they were teaching. They valued it highly, as did their schools and the students they are teaching."*** *From Appendix D*

## Future Considerations and Suggested Improvements

### *Considerations for 2022*

Planning for future summer ROSE Programs has been ongoing, and the assessment results will contribute to decisions about coming years. Key issues which will influence the program budget and logistics include the Scholar and PI recruiting process, the size and duration of the summer research experience, and the composition of the Scholar cohorts.

**Recruiting**. Scholar and PI recruiting was compressed into May 2021, but the schedule should be expanded in future years, beginning with recruiting announcements in January and application and selection in March and April. The timeline should allow for widespread publicity, planning by potential Scholars and a more considered selection process. The announcements in the PED STEM Connect email newsletter generated a large pool of applicants, but using multiple mechanisms (direct emails from the ROSE Program; website and event announcements) might ensure wider coverage while providing more detailed information on the Program. The application process should provide more time for potential Scholars to apply, and a longer period for the selection itself (2-4 weeks). The application form should be re-designed to provide more useful data about the potential Scholars, both for the selection process and for longer-term assessment. The publicity and the application should emphasize Program accessibility: expectations would include Scholars with minimal preparation and some flexibility in daily schedule to accommodate Scholars with family responsibilities. Recruiting of PI mentors should begin early in the Spring semester and possibly be expanded to include faculty conducting chemically-oriented research in other departments (Chemical and Biological Engineering, Physics, Biology, Toxicology, Environmental Engineering, etc.)

**Size and Duration.** The 4-week pilot for 8 Scholars met the time (Fiscal Year) and financial constraints of available funding from PED and the UNM OVPR, but subsequent discussions have suggested that a slightly longer summer research period (5-6 weeks) for a larger group of Scholars might be preferable. A longer program would allow for more formal activities and better conclusions to some research experiences, while a larger cohort would allow for more interactions among Scholars and increase the reach of the Program.

**Program Organization.** The following questions need to be considered for Summer 2022:

- Is 5 or 6 weeks preferable? Added length may complicate scheduling for some Scholars.
- Should the number of Scholars be increased to 15? 20? 25? The optimal number may be somewhat higher in the long term, but both the logistics of the Program and need to assure funding suggest this is a good range for 2022.
- How many PI mentors should be recruited? This will depend on the number of Scholars and the Scholar:mentor ratio, which could be 1:1, 2:1, or some intermediate value.
- Can stipends be provided for graduate students who devote significant time to mentoring Scholars? For administrative assistance? For faculty organizers?
- Can out-of-town Scholars be housed on the UNM main campus? This would minimize commuting and parking issues and facilitate 'cohort building' through proximity for meals, etc.?

Future considerations include:

- Should ROSE expand to cover teachers in other science disciplines? Chemistry is the current focus, but Physics, Biology and Earth Science instructors should also benefit; the interdisciplinary nature of research was an important revelation for many of the Scholars.
- Should ROSE expand to other research universities in NM (notably NMSU)?
- Should ROSE be used to open other formal interactions between UNM and high schools? For example, we could initiate a 'science speaker' program to send UNM faculty to high schools, or schedule Zoom lunch meetings between high school and UNM students.
- Should ROSE expand to include post-secondary science educators at 2- and 4-year colleges without extensive research facilities (e.g. CNM, Navajo Tech, SIPI, New Mexico Highlands)?

**Scholar Cohort Composition.** ROSE is intended to improve secondary science education, especially for URM students, by engaging teachers in research. While the first cohort of Scholars was selected in only a week based on high school student body URM make-up and geographical considerations, other criteria might also be considered:

- What is the optimal rural:urban school ratio?
- How important is geographic distribution throughout New Mexico?
- How important is the percentage of URM students at a school versus the total number of URM students?
- Should a single school have multiple Scholars in the same year?
- Should Scholars be allowed to repeat the ROSE experience? If so, how often? Is there an optimal 'target' percentage or returning Scholars in a given cohort?
- Should the academic degree(s) of the scholars be considered in selection?
- Should the application require an essay or other significant writing?
- Should non-PED schools (parochial, private) be allowed to send Scholars?

***Additional Considerations***

PI mentors and scholars had specific suggestions for additions to the ROSE program to improve the selection process, summer experience, and follow-up.

**Pre-summer actions.** Several Scholars recommended some official contact by the PI mentor after Scholar selection by phone or Zoom. Besides establishing a welcoming personal relationship, this could be used to suggest reading materials (or other research preparation), discuss expectations, learn more about the Scholar and answer questions about the summer. Posting orientation materials on the ROSE website could be a useful supplement, but not a substitute.

Advance notice of professional development credit recognized by NM PED would be helpful to Scholars and serve as a possible recruiting tool.

**Summer experience.**

*Housing.* On-campus housing, as mentioned above, was cited as more convenient for Scholars, possibly more cost-effective than hotel housing, and a better way to allow Scholars to get to know the University and each other.

*UNM and Albuquerque orientation.* Since many of the Scholars will be from out-of-town, some introduction to Albuquerque and the UNM campus could help them adapt to their summer environment. A campus tour and possibly a field trip to a museum or Old Town could be arranged for the first on-campus day or the preceding weekend; other field trips and events could continue throughout the summer program (trips to Sandia Crest, IPCC, Old Town, Natural History and Explora, etc.)

*Program orientation*. The first day orientation program could include formal introductions to UNM faculty participants and Department staff. Returning Scholars could potentially serve as mentors (or orientation counselors) for new Scholars to facilitate the adjustment to UNM and the research environment.

*Program activities.* While Scholars appreciated the weekly lunch meetings, some of them felt more structured activities would be useful, including:

- Research presentations by faculty, PI mentors and perhaps others.
- Social activities including UNM students and faculty.
- Meetings and/or panel discussions with UNM instructors to discuss chemistry and science teaching, including laboratories.
- "Brainstorming" sessions: time to talk with each other about how to bring their new knowledge and skills back to the classroom, perhaps supplemented by UNM faculty contributions or resources (websites, software and tools).
- More structure to group lunches (seat assignment, discussion topics) to promote broader connections (so the PIs don't simply talk to each other and/or the Scholars from their own labs).
- Poster presentations on research projects (which Scholars could take back to their schools).
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**Follow-up**. Scholars appreciated continuing contact, which is currently very informal. Some requested a more formal mechanism which might include school visits (by PIs or others) or Scholar meetings (in person or by Zoom) during the school year. Scholars also requested additional information for their students on how to prepare for and apply to UNM.

**Appendix A. Interview Goals document from July 2021**

# Goals of Assessment:
# What do we want to learn from this pilot project?

***Recruitment***

Where to 'advertise' other than STEM blast?

Optimal timing for recruiting announcement(s)?

Would other factors (child care? Transportation? Training "credit"? etc.) make this more attractive to you or other teachers?

***Selection process***

Is the process transparent? fair? aligned with UNM goals? aligned with PED needs?

When would be an optimal time to learn of acceptance?

How much time is needed to respond to an acceptance?

***Logistics***

How suitable are housing? stipend payment? Travel reimbursement?
Parking? UNM access? Time period (4 weeks? 6? 8?)

***Activities at UNM***

How useful/suitable were

Orientation? Lunches? Meetings w/UNM folks? Final presentations?

Suggestions for additional scheduled activities? Other activities generally?

***Effects on scholars***

What did you learn?

What new skills did you acquire?

Do you have a new appreciation of the science you worked on?

What had the greatest impact on your understanding of science? Of how scientific research is accomplished?

Has this changed your views of scientific research (generally)? How?

Has this changed your views of research in chemistry? How?

Has this changed your view of UNM (generally)? How?

Has this changed your view of UNM CCB? How?

Do want to participate in additional research projects (any type)?

Would you want to participate in future ROSE projects at UNM?

Would you recommend it to others?

***Effects on PIs***

What effect did the mentoring have on you personally? Professionally?

How did the scholar's presence affect your research group?

How did the scholar's presence affect your research progress?

Do you think you will stay in contact with your scholar(s)?

Will you plan to participate in ROSE next summer?

What would make this a more attractive experience as a PI- stipend? Role in scholar selection? Other activities?

***Effects on secondary student/schools***

How did this summer experience affect your teaching?

Have you used any tools or ideas from the ROSE experience in class? In working with individual students?

Have you discussed your research with your students? With other teachers?

Have you discussed UNM with your students? With other teachers?

What would make ROSE more useful to your students and school?

## Appendix B. Mentor Interview Report from Dr. A.J. Stewart

### Evaluation of ROSE Program from the Perspective of Faculty Mentors

**Abigail J. Stewart**

**August 23, 2021**

### Overview

The five faculty mentors' perspectives on the program were assessed in this analysis. Like the participants, the faculty mentors found the program overwhelmingly valuable, worthwhile, and well-organized. All of them hope to work with the program in the future, all have continuing contact with their Scholar mentees, and all pointed to gains for them and for the Scholars, as well as for the department and UNM, from the ROSE Scholars Program.

The initial phase of the program was viewed universally as successful and needing only very minor tweaking in the future. The faculty viewed the recruitment, selection, and matching processes as uniformly successful. Many felt a pre-program contact could be valuable, if it was not intimidating for the Scholars, and really was limited to an expression of enthusiasm about their participation. While they were equally satisfied with the orientation process, they felt a few changes would be useful: more consistent introductions of the faculty mentors; a more systematic tour of campus resources by PIs and/or graduate students; and explicit coverage of the expectations for onsite participation (which they also thought should be outlined in advance with care).

Faculty mentors found their experience with their Scholars to be personally satisfying, effective in terms of the Scholars, and valuable for their graduate students. Only one reported that it was more time-consuming than hoped, but that mentor noted that it might have been the result of the graduate mentor-Scholar match in that case. All the mentors outlined numerous benefits to all concerned in detail. They also valued the plenary activities, but hoped for more structure in faculty-Scholar interactions, as well as more official space for the Scholars to exchange ideas about what they might bring from the program back to their students, as well as more "fun" and relaxing activities. All of this would be facilitated by a somewhat, but not much, longer program.

All mentors were enthusiastic about expanding the program's reach, but they were divided on whether to allow Scholars to participate more than once. That said, all recognized that there could be value to the Scholars to participate more often; there was differential weighting of that benefit and the importance of expanding the program to reach more people and schools. Mentors generally felt it was actually valuable to have two Scholars in a single group rather than one, and some favored a hybrid model in which one of the Scholars might have participated in the past. Faculty mentors were divided on the question of incentives for mentors. There was some agreement that funding for graduate student mentors would be appropriate, and that some research expenses might be as well, but there was considerable disagreement about seeking support for PI time.

Many faculty mentors expressed enthusiasm for the program's capacity to contribute to the state's high school science mission, and felt this was an important opportunity for faculty at UNM. They all made insightful and helpful suggestions about future iterations of the program.

**The Interviews**

One-hour interviews with the five faculty mentors in the ROSE program were conducted via Zoom between July 26 and August 17, 2021. Interviews focused on mentor experience in their program, and their assessment of the Scholar experience, as well as their views of potential changes in the program for the future.

**Initiating the Summer Program**

All the mentors described their role in selection as minimal but entirely acceptable. One noted that "we had an embarrassment of riches" in terms of applicants, and several pointed out that they could have matched with several Scholars. Some indicated the importance and value of the open-ended comments by applicants and urged that the future application focus on that. Some also felt that clearer understanding of the weighting of criteria in selection would be helpful. None wanted more personal involvement, and all felt the result, despite the rushed process, had been great.

The mentors' satisfaction with the process was reflected in their reports on the degree of fit between their Scholar(s) and themselves and their research. These were described in language ranging from good to fantastic, and included references to their great personalities, excellent progress, good teamwork, and more.

Asked about a potential future practice of a pre-arrival Zoom or phone call, one mentor indicated they had done that and found it useful. Another indicated they had emailed in advance and that seemed sufficient, but some prior contact was a good idea. One thought such a contact would be more useful in the application and selection phase, and was not necessary once Scholars were selected. Although one thought it was a "wonderful idea," two were concerned that there was a good chance such a contact might intimidate Scholars, and even lead them to withdraw from the program.

All the mentors felt the orientation program was very successful and impressive. Two felt it was important to increase attention to the program's expectations from Scholars (both before and at the orientation) to head off their involvement in competing activities. This was mentioned more than once in other sections of the interviews. One mentor commented that the Scholars did not all have a broad or comprehensive understanding of what scientific research is like; in fact, they felt that the document prepared by one of the organizers on this topic was outstanding and really a model of what the Scholars did need. In contrast, none felt it would be productive to have formal research descriptions by each faculty member at the orientation, though most also felt doing that later in the process—perhaps at the midpoint—would be valuable. One noted that formal introductions of each faculty mentor (or planned formal self-introductions) would be

helpful at the orientation. Overall, the mentors were very pleased with the orientation's successes, and although they had suggestions about things to add, they were in the spirit of adding to a very successful program.

Suggested additions to the orientation included:

1) Explicit discussion of expectations of Scholars
2) Thorough tour of campus resources, by PIs or graduate students
3) Faculty introductions

**Assessing the Program for the Scholar, for You and for Your Research**

None of the faculty mentors felt that the program was too short, and all suggested it should be at least a little longer; one thought two months would be about right. All the rest worried both for the Scholars and the mentors that it would be easy to make it too long. Recommendations ranged from four and ½ weeks (2 people), five weeks (1), and 5-6 weeks (1). One noted that it was difficult for either the Scholar or the mentor to assess success when the goals of the program were not clearly defined; perhaps outlining the actual goals (Exposure to research? Learning tools? Completing a project? Participating in a project? Identifying important things for high school classroom that were learned?) would foster a greater sense of accomplishment and clarity about what "success" really is.

In outlining the impact of the experience of mentoring ROSE Scholars on them, faculty reported a range of experiences, including finding it "average" (in that there were problems with one Scholar that got ironed out) or "good," a source of a lot of information about high school science education in New Mexico, and helpful to learn they had something valuable to contribute to state high school science education.

Mentors outlined things they felt the Scholars gained from the program, in many ways:

- appreciating the unity of science
- understanding the impact of computing on scientific research
- concrete tools
- how to find more tools
- they learned some science
- seeing the research firsthand
- getting an idea of what kind of stuff people need to know [for college and grad school]
- knowing what careers are possible
- how interdisciplinary everything is these days
- getting the hands-on experience
- the ways in which biotechnology or biochemistry is being used to work on modern problems.
- having a concrete link that there are using these tools to work on [important social issues like] the antibiotic resistance crisis
- free program that will use in teaching

Interestingly, mentors felt that the impact of the Scholars' presence in their research groups ranged from neutral ("I don't think it really affected it too much"), to smooth and seamless integration, to exceptionally positive. One reported that after working with a very difficult student for some time, "what the Scholars did for me, is they renewed my faith in the research enterprise and dealing with students." Others pointed to the very positive impact for those of their graduate students particularly interested in outreach and education. They noted that the graduate students

> need to think about how to present their research, they need to think about how to basically teach somebody who never used the software they used previously, and effectively communicate with the ROSE Scholar. I think that's a wonderful, wonderful experience for the graduate students to my group.

Another commented that

> it did allow them to continue to perfect their mentoring skills. I went to lunch with the Scholars and the [grad student] mentors a couple of times and we talked about how they would incorporate stuff in their classroom, and the graduate students get to be in that conversation, which I think is important; teaching and research and scholarship is more than just plugging away and running reactions right and analyzing data. It's thinking about how to package the data in a way that is palatable to others. So, I think that was really important for them.

Mentors' comments about the impact of the Scholars' presence on the research progress of the group were also overwhelmingly positive. One noted that although one Scholar in the group started, but couldn't complete, a new project, the lab was interested in pursuing it now and would; the other Scholar "pushed the research forward," so the project they were on "actually made progress." Similarly, another commented that

> actually one of my grad students is picking up the project she was working on. An undergrad had been working on it previously and she got a step to work that the undergrad hadn't been able to get to work. So, it helped move it forward.

Another commented that it helped with bringing a new graduate student into the group.

> I think it was actually very helpful. Everyone got along great. There's a student who's starting the graduate program right now, and I hired him to work in the lab over the summer, and the two of them both started on June first. And so I think that kind of gave the two of them like someone to lean on as being the new person

One faculty mentor said it "definitely took time away" from research progress, but was totally worthwhile nevertheless.

Asked about whether they had learned new things about New Mexico high school science education/, one mentor said no, it was "as bad as I expected." Others indicated that they learned a lot about the lack of lab resources and the difficult transition from the form of high school teaching (making it fun) to college lectures. Others noted that "the landscape is even more diverse than I thought," and that high school teachers must write grant proposals to try to fund

lab resources. One also noted that they were unaware that chemistry was not required in the high school curriculum, and also didn't know that high school students have considerable strength in programming. One noted that despite these difficulties "the Scholars are SO dedicated to their students; I remain blown away" by that.

The mentors all thought that the Friday plenary lunches were important, but thought they would be more effective if more structured with formal planned interaction (one noted that both faculty and Scholars are not "social," and these events were hard for them to make successful). Several people noted that COVID and the building renovation made these difficult to structure, and thought it would be easier in the future. Several also noted that it was not easy, in the given format, to interact across groups, partly because people didn't know anything about each other. That said, all suspected that the events that occurred were useful, but might be augmented.

In terms of additions to the programming, faculty mentors suggested:

1) brainstorming space for the Scholars to think about teaching/what they will bring back to their classrooms, how they will communicate range of kinds of work/science going on and way it all integrates different features of different fields
2) more interaction and supportive structure for interaction
3) more "fun" activities, like day trips to museums/nature centers/meal in Old Town
4) more explicit plenary direction about final talks from beginning
5) tours of other labs in CCB

**The Future**

All the mentors are continuing in contact with their Scholars a month or more after the program, and all plan to continue that. Some focused on the human connection, others on updating them on the progress of the research, and some are continuing to collaborate. Several also mentioned that they hope to help the Scholar(s) in their classes by visiting (in person or remotely), and somehow connecting with the Scholars' most engaged students.

All the faculty mentors would like to participate in ROSE next summer. All expressed a mild preference to take two Scholars, because "they're both strangers so they can kind of bond together and help each other," it would "allow someone to kind of lean on to some extent," and because the interaction between the Scholars and with the graduate students in the lab is so valuable. One felt that their experience with two was difficult in being too much work, but suspected that structuring the arrangements differently would likely allow for these benefits.

The faculty mentors were divided in their views on whether Scholars should be allowed to participate a second (or more) times. One was a strong advocate (because it would be a much more complete experience for the Scholar), and one a strong opponent (in the interest of broadening the reach of the program and the belief that faculty can always find ways to support bringing someone back to their lab if they really want to do that). The remaining three were attracted to a hybrid model in which some returning Scholars would be accepted, but the larger

part of the program would be reserved for new Scholars. These mentors were inclined to see some benefit to having one returning and one new Scholar assigned to the same lab (another mentioned the value of having two people in a lab from very different kinds of schools or communities).

The issue of incentives for the faculty mentors was also one on which the mentors did not agree. One was a passionate advocate for covering all costs to mentors in terms of their salary, support for grad student mentors, and funding for supplies and equipment ("there should be no hidden costs"). Two were strong opponents, on the grounds that the incentives are intrinsic (a responsibility to contribute to the state's public science education) and adding financial ones unlikely to attract people who would be good additions to the program. They also felt that university and PI resources are very adequate to support the program. Moreover, one opponent expressed the very strong view that layering in more costs to the program would make it very difficult to keep the program funded and sustainable over the long term. The remaining two were not enthusiastic about salary for the PI (though they appreciated the generosity of the desire to do it); in contrast, they thought some support for graduate students who took time to mentor the Scholars was appropriate. Many of the mentors pointed to the importance of the "broader impacts" criterion for NSF funding and saw that as incentive enough for the program, as is "improving our image" both in the university and in the state. One noted that "just learning that the program was not a massive time sink" would be incentive enough for many.

Comments that faculty mentors made that were not fully covered in the interview protocol included:

1) Need to figure out how to fund the program
2) Possibility of corporate sponsorship as well as public funding
3) Need to work at all stages of pipeline including getting science students into science workforce
4) Scholars were paid too much; will add to difficulty sustaining program
5) Need more PIs to commit to expand the program
6) Need follow-on programming; an example would be to invite Scholars (as a group) to campus AFTER program (sometime in fall or winter) for poster session in department along with their students
7) Maybe offer a chance to change lab assignment on first day

**Appendix C. Scholar interviews round 1 by Prof. A.J. Stewart**

**Evaluation of ROSE Scholars Program at University of New Mexico Summer 2021**

**Abigail J. Stewart** **July 2021**

## Overview

Interviews with the 8 ROSE Scholar participants were conducted between June 23 and 30. The program ended on June 25, so four of them were conducted just before the end; 4 after. Interviews were conducted on Zoom, and ranged from 30-60 minutes, with an average around 45. Participants provided written consent before the interviews, and were invited to ask any questions at the beginning. All expressed willingness to participate. Interview 8 was conducted by phone, not zoom, due to connectivity problems. Therefore I took notes as ROSE Scholar spoke. May not be quite verbatim. All other quotations are verbatim. The interview questions are listed below before a summary of the responses. In a few cases not all scholars answered a particular question. If the description of results does not mention any disagreement, that means there was none, even if not all participants answered the question.

The program was, as is evidenced below, enormously and universally successful, in the eyes of the ROSE Scholars. Participants came with high hopes, and those hopes were met and exceeded. They greatly valued, in particular, the opportunity to do hands-on research with mentors they perceived as both patient and supportive, and brilliant. They felt this experience provided them with many resources to bring to their teaching. Few thought much needed to be changed, but there were some suggestions for consideration by the planning team:

--most participants felt the program was too short but two pointed to difficulties if it were longer;

--the lunches and the presentations were both highly valued, but there was some felt need for them to be more carefully structured to ensure full participation and equity;

--the ideal timeline for applying was consensually agreed to be: announcement in January or February with applications due no later than early March, and notification by early April, with a short deadline for response (a week);

--some would have liked an explicit provision for preparing materials for teaching and talking with each other about that.

**Can you tell me a little about why you applied to the ROSE Program and what you hoped to get out of it?**

Participants generally expressed great excitement about the opportunity to do research themselves as the primary factor that attracted them to the Program; some also expressed enthusiasm for the subject matter. Direct quotations from each follow:

1) when I read about the program-- the ROSE program-- and it says molecular modeling, I said, yes, that's the-- those are the two words that attracted my attention to join the program: when I saw molecular modeling is it, I need this.

2) I really want to experience firsthand a real research. I did research back in college, but it's totally different from the research descriptions that were sent along with the email. And so, basically, that's my main goal: to experience firsthand research at the college level, you know, working with the experts in their field. (what attractive?): The acronym-- research opportunity for science educators-- and I'm like okay research opportunity. That means we're not just going to be observing. I'm not just going to be like you know asking questions, if they talk about something weird and we're not familiar,we are actually part of the research process.

3) I was trying to make the connection between the knowledge we teach and actually the application of the knowledge

4) I really like to keep developing my teaching and I don't want to just sit there but. So I saw the opportunity and I thought it was really great. One of the things is to kind of reinvigorate the love for that science as well. I've noticed that, even by doing the program, but it was it really was just something that really caught my attention of an opportunity that really we don't get as educators, you know, and we're so far removed sometimes, over time, that you forget what's currently going on so you're trying to tell these kids: This is what is going to happen in college and these are the kind of careers, but I've been teaching now for over 11 years, my 12th year coming up that it might not actually be accurate anymore… So it's a nice thing to just get that love back, and remember why, you know, I love the chemistry. [also what attracted?] I think it was talking about doing like the research side of things. And the moment I see, oh research, that's great. Like, that's something different. I mean we get hammered with professional development, professional development. It starts turning into the same jargon, and I, I'm like, guys, this helps maybe with like English and history, science is a different beast sometimes, and the approach isn't always the same. And so, and some of the science PDS we get, it's more generated for middle school and lower a lot of the time. So makes it trickier. So when I saw that there was something that was higher level I thought that that was a great opportunity

5) It was a very unique opportunity that I hadn't seen for 20 years—to be able to go into a research lab and don't have to worry about anything else—that was very attractive to me. I've done a slew of PD workshops and this was different in the aspect that it was solely research and that was very attractive to me.

6) I need to be exposed with the current, you know, the trend in the science content, and ROSE program, to me, is an answer on. You know I've been looking forward. I'm looking forward to this kind of training so when I got information. So right away. I grabbed the opportunity I filled out the form. And I even asked my principal about his thought about, you know, joining this program and he said like, go for it i think is perfect so that's

another thing that I really wanted to be in the program, because I got the blessing from my principal.

7) I was really really excited about this program actually, because there's not a lot of good PD for teachers, especially, and I actually am I'm kind of in an interesting spot, because I'm a researcher too, so I have my own research project up where I live. And so I'm always trying to get the students involved with more research based things, especially with the universities, because the universities don't reach out as much as I think they should sometimes

8) What could learn about science and improve teaching. Wanted lesson material and got that—especially re using natural products in pharma drugs. Found what looking for. Use it to study both chemistry and biology.

**Anything not sure about or worried about?**

Several participants expressed anxiety in advance about their own lack of preparation or "rustiness" and their desire to avoid being a liability to the projects they were assigned. One also worried about the long time away from home; another noted that the unstructured time was difficult to adjust to after a career in schools with rigid timetables.

1) when I read in the [abstract] that I need to use computer or supercomputer, I said, oh my gosh, I have no knowledge about it

2) I was worried about the time of staying on the campus for four weeks straight. [kid issue]

3) I was a little bit concerned, or not sure, I would say, that are the connections, like we expect to find this one thing meaningful, like, apply the knowledge,

4) I'm a little bit rusty… I was a little bit nervous at I guess being the weak link slowing down anything that you're working on; you know, I don't want to get in the way, was my worry

5) Logistics, and being out of my comfort zone. I've been teaching for a long time, and I have a knack for it, so this was different and there was a little anxiety there—the unknown.

6) Information provided addressed logistics and preparation

7) I was a little bit intimidated at the beginning because I was like because I knew that the other places had like researchers in there all the time and a team in there. So I was, you know, so it was a lot more work for the two of us that got placed with the professor working on computation, but I really liked it. I feel like I learned a lot more by not having the graduate students there, because I noticed that the other teachers had. I noticed that, after we did the presentations at the end, I noticed that the teachers who had were in the lab with the graduate students, they couldn't answer the questions as well.

8) Very different and hard to get used to: teacher schedule and PI schedule not compatible; teacher dictated by school schedule and school year; bells/planning/way ahead/there till bell rings; very rigid schedule; forgot that it's not rigid, PI has flexibility about time and many different kinds of demands for meetings etc.; lots going on, not going to be there all the time; in advance: how make best use of time? Needs to be a bit more structure to the four weeks; would've helped. Did have some things to read and protocols to look at but maybe not enough. Maybe some goal-setting, clarity about when doing what; seemed very open-ended.

**Recruitment**

**How did you learn about the program?**

All of the participants learned, directly or indirectly via forwarding, from the New Mexico Public Education Department (NM PED) summer opportunities for teachers newsletter. One pointed out they only heard about it—since their school is federally rather than state-funded—via a friend. Another had a department head forward it.

**How do you think teachers might learn about the program differently?**

Most participants thought the NM PED newsletter was a good way to learn, but one noted that it might be good to proactively reach schools not part of NM PED, like military, private, etc. One commented that it would be good to send as separate notice (rather than in an omnibus listing), so teachers can find it more easily. Another noted that If it came from UNM directly it might have more impact, and (as several noted) "sometimes teachers delete things from PED." If UNM could directly use the mailing list that would be good too. Maybe both ways. Finally, one suggested also posting it on the NM PED website.

**When do you think would be the ideal time for the ROSE program to be seeking applicants in the future?**

All suggested very early after the holiday break—January or February.

**The program this year was four weeks; what do you think is the ideal time length for the program to ensure it is valuable to the participants and does not impose too big a burden? June or a different time?**

No participant thought it was too long. Two said the time was too short, but it is the longest that would work for teachers. The rest suggested that 5-6 weeks would be better, with one even suggesting that projects could have variable end-dates, depending on what was needed. One noted that "Six weeks is ideal, but knowing when to start and end difficult. Could there be a part that is asynchronous and virtual, e.g., through Canvas? Could assign some stuff ahead and after an in-place program to deal with timing differences. Could hit the ground running when in person." All respondents noted that June is ideal.

**Are there practical supports to the teachers that might make the program more attractive to a wider range of applicants?**

**(Probe if needed re: child care, transportation, professional development credit)**

Most participants described the supports as generous, and strained to suggest more things. However, three mentioned the value of getting graduate credit, and two of professional development credit (and knowing about it in advance). Two indicated that support for child care expenses would likely be helpful to some, and one noted that the hardest thing for parents was the long time away from the family (maybe suggesting a planned break to go home with funding for travel?). Finally, one suggested that housing on campus would lessen the anxiety about safety that many from rural areas experience in Albuquerque.

**Any not needed?**

No participant identified any support they had received that was not needed.

### Selection

**When would be the ideal time to learn that you have or have not been accepted to the program?**

Most participants suggested late March or early April. Two thought later (like mid-May or a month before) would be okay.

**For those who have been accepted, how long is needed to decide to accept or refuse the offer?**

All participants thought 2 weeks or less was sufficient; most indicated a week or less.

**How did your match with a lab work out? Do you think it's important for applicants to have more choice in their lab assignment?**

Most participants felt the amount of choice was sufficient and that their match had worked out well. For example, one pointed out that "I got my second choice, but I realized when I was making my PowerPoint presentation the other night, and then presenting today I realized that I am just in the perfect research, where I wanted to be." Another said, "The topic that was given to me was available that time was in an area that is quite different from my field of experience, but I thought there was a challenge on my part like to go out from my comfort zone. And I thought, and I consider that as a challenge. I would really want to have more choices like more professors, participating the program, so that there will be more options and choices for teachers aligned to their practice or to their concentration area." A third, who was satisfied with their match and the process this time, indicated, "I don't know if that's possible, but when they get notified they get notified of who they get placed with, and then they have a week to accept, and to see if they feel like they're, like, that's not a good project for them." Finally, one who typified those who were totally satisfied said, "Perfect match! Was interested in enzymes (does an enzyme unit in school); learned something didn't know before; rocked my world! They do what?! More than

one way to make proteins! Wonderful, eye-opener. Blown away. Extremely bright PIs—great respect for them. Hopes did them justice in presentations."

### Activities

**Which of the group activities of the program struck you as most useful? (Probe for orientation, lunches, meetings with UNM folks, final presentations)**

All of the participants described the lunches as great and helpful for getting to know each other and the PIs. They also noted the value of talking with the UNM administrators, especially for facilitating more two-way communication between UNM and the schools. One mentioned that a greater focus on communicating with visual images would have made communication more effective. And another suggested that the PIs varied in how much they interacted with the teachers, and that was frustrating and disappointing. That person suggested more structure would have been helpful, in creating the groups and in focusing the conversations. Another participant noted that they didn't get to talk with everyone, or learn about all the research going on, because of the lack of structure.

Five of the participants named the orientation as very helpful, and often singled out the safety presentation as unusually concise, pointed, and rich.

The final presentations were also mentioned as crucial or important by all but one participant, though one thought it would be helpful to have clearer information about expectations for the presentation in advance. Note that four of the interviews took place before the final presentations, so only four really could comment on them after-the fact. Of these, two felt that the presentation format needed to be more tightly streamlined and monitored so that they were equitably allocated time.

**Do you have suggestions of activities that you'd like to see added to the program?**

Half of the scholars had no suggestions of additions. One suggested that there should be a mechanism to make sure ROSE Scholars really do participate every day and the PIs too.

Another mentioned that their PI took the ROSE scholars in lab to lunch weekly, once with grad student mentors, otherwise alone; they really valued that and recommended it in other projects. Another noted that it would be helpful to inform teachers more in advance about what they need to bring. Two noted that in addition to the oral presentations, they would like to have something "published" (internally or on the web) from the projects. One noted that they would like to have "something you could post in your classroom or in the hallway" [maybe a poster?]. Finally, one participant felt that there should be more time allocated—maybe even a whole week—to figuring out what you can bring back to your teaching and perhaps presenting/discussing that with each other.

**Are there activities you think could be dropped?**

No activities were named by anyone. One participant said, though, "avoid having presentations cut into research time."

**Down time/relaxing/consolidating information**

All but one participant stressed how much they appreciated that there was time to reflect, consolidate and relax, particularly because their time was not too structured. One answered, "

I'm neutral on that; Not too much pressure, but did not always have enough to do. Would've liked more to read/more literature."

**Impact of the Program on You**

**What do you think are the most important things that you learned during the program, whether from group activities or from your work in the lab? What are you most excited about that you learned?**

The participants outlined the program's powerful impact on them in every case. For that reason I have left in their verbatim quotations about it. Some focused on the impact of learning and experiencing new things; others on the way in which past and current knowledge integrated and created a more meaningful whole. In every case, though, participants reported that the impact was positive and substantial.

1) The most important thing that I'm excited about is using different programs to do a simulation of different proteins, and when we saw-- when we use the supercomputer to give some commands and do the simulation, the simulation is really really exciting. But when we were able to use the simulation to create graphs, then it makes sense that-- oh why is the simulation doing this; when we saw the graph, it makes sense.
2) So one of the things that I'm very very excited about is, is knowing and understanding that when proteins connect with their ligands, you can measure it, and you can graph the results and you can compare these results. So simulations are fun and cute, but if you have data that you can actually share with other people… so the interdisciplinary application of s chemistry and physics and statistics because we have to compare these different types of proteins using standard deviation. Whoa!! So I am very excited about how I can make this simple for my kids –for my high school kids.
3) Everything seems to connect at the quantum level: biology, physics and chemistry…Another takeaway is more like the practice of the research experience and the tools we get are like more knowledge, quantum mechanic knowledge about atoms and molecules. We get to use them. And to model them, and apply them. It involves a lot of PD, because we learn about Python, and many packages, machine learning, and many many packages. And also data science, how to plot with our Python language. Yeah we did a lot of PD within this short period. So that's a lot of content for PD.
4) I'm just jazzed to tell them about the research, you know like, to be able to get involved in something that you don't get to experience as a teacher… and it was just such a great experience to see how the applied lab techniques, the instrumentation

they used, what kind of things we should probably think about covering more, that ties into this… I think that's what I'm really want to bring back to my peers is: just what did we work on [in the ROSE Program], and how does this tie to what we're working on [in high school].

5) The opportunity to be in a research lab that's during groundbreaking current research. The hands-on opportunity is invaluable. We got not just to read about it, but to be a part of it. That's amazing!

6) it's like the ultimate professional development training for me. So there's a lot of takeaways I can bring, you can share to my colleagues to my school and to the district. Number one is the practice of research itself. And I think that's what's lacking in our school district that in the. The somehow. Research is going to be incorporated in our curriculum. When they go back to school, I would like to share my whole journey… And I'm just so excited to share my lesson activities to do my other science colleague at so great.

7) the really exciting thing for me was really being part of something bigger and really getting the opportunity to learn about what's happening at this university, and about what's happening in research and in the field of chemistry, so I just was I really really enjoyed all the aspects of it so it was very rewarding.

8) Tie this to outdoor education; segment about herbal/medicinal plants in the bosque; applying for a grant.

**Use with students?**

All of the participants expressed the view that they had learned many things in the program that they were eager to share with students, and that they thought they would be able to incorporated into their pedagogy.

1) I asked my primary investigator—[they] asked us to do a protein simulation for the other Scholars, and I'm thinking if we can use a simulation that we could use in our classroom. Because it doesn't make sense if we show them a simulation and yet we can use it in our classrooms. So they said, since we don't have supercomputers in our school that we need to use a small molecule, so that our laptops can handle the simulation.

So they suggested us to use caffeine and adenosine. And I'm very glad, because in biology, we talk about enzymes, the binding of enzymes, and the protein. And so this is a very good example because we can we can, I can even teach my students to actually do the simulation using a free program just using our laptops

2) knowing and understanding that when proteins connect with their ligands, you can measure it, and you can graph the results and you can compare these results… the interdisciplinary application of s chemistry and physics and statistics because we have to compare these different

types of proteins using standard deviation. … I am very excited about how I can make this simple for my kids –for my high school kids.

3) I learned how to let the student visualize the data. For example, I modeled interactively with our Python plot package… And that could be very good to teach biology students and chemistry students, or the physics and say: You see this is our atoms and molecules, this is how they enter to connect to the cell membrane, so it could be a very authentic project for the teaching. And with tools like Python, we could use as teaching tools.

4) because we were mainly inorganic chemistry; in this, I was doing organic synthesis, so it's a little bit different, but I realized I could pull a lot of these organic terms into my class, And that would probably make them feel a lot less overwhelmed when they get in college later on…. Letting them know what's going on because then they can share that too; like this is what's at the forefront, but try to get them excited about that.

5) Absolutely! …now when I develop a lesson plan I can rely on my experience about how these things are studied. And I also learned new concepts that I can embed throughout my lessons. What does the research look like? Bringing that perspective to them, maybe let them do projects, and really recruit them not just to UNM—it's not boring, it's not oriented just to males, the group I participated in was very diverse!

6) first I have my PowerPoint presentation, all the, you know, all the tools that I need in class and I want to share them to all to all my students….The use of different equipment, and the instrumentation will be the highlight of my presentation, because I see now, our school doesn't have those. I wanna at least like showing the pictures like with me with using the using the equipment. My students can see that research is fun. And I think that's what's lacking in our school today. A lot of students are scared about doing lab, and scared doing research because they thought like research is only for people who are smart, and they're not qualified to do that. And I'm always wanted to emphasize that research and doing these cool experiments is for everybody. And one thing that I realize:in the lab, the people that I work with: there is diversity, and I want to emphasize that the research is not [only] for men. Researchers are doing experiments doing work in the lab are not only men. This is this work is also for women, different background. Right. So I want to highlight that. And I really wanted to invite my, my students to pursue college, and want them to experience research. My goal is to motivate them. My goal is to inspire them to pursue their dreams to do to pursue STEM career. And another thing that I want to share is after all the experience I really wanted to write lesson plans and curriculum that in based on the you know the topics that I learned, and I want to incorporate that to my lesson.

7) Yes, a lot…. And there's tools on the internet, like these databases on the internet, like the protein database. I knew about it because I used it when I was a researcher, but I never really thought of incorporating anything with it into a high school class, and now I do and now I see an application for it. Anything visual and anything that they can share on the computer, that people can use at the school easily, which they do have, are things that are going to help.

8) Types of medicine derived from natural products, including neuro-transmitters. Natural products could be used for more products (so far more for dyes/tinctures, skin and gut issues, but what about depression?) Tie to environmental/outdoor education.

**I will ask you about some different kinds of things you might have learned or gained; feel free to let me know whether you did or did not! Are there new skills you acquired?**

All but one participant stressed that they had gained new skills. These focused on tools for visualization of complex processes, knowledge of programs and procedures, and (especially) equipment they had never seen before. One described the transformative impact of this new exposure this way: "The scale at which I've done chemistry was you know milliliters, we didn't go really below millimeters too much. I'm using microliters. Yeah 1000 times smaller than what I'm used to, and so I'm using the syringes now instead of graduated cylinders." Another described the experiences as "mindblowing" and also pointed to both the cooperation essential in the lab and the capacity for problem-solving as things that were powerful experiences. Only one student was more moderate; that on said: "Not new, but a refresher; had learned some biotech procedures before, but allowed to practice."

**Increased awareness of trends in the area of research you worked on?**

All of the participants reported that they had increased awareness of research trends from participating in the ROSE Program. Some pointed to the transformative impact of some new knowledge (e.g., that bonds are not fixed), while others pointed to amazing developments of laboratory and visualization capacities ("I never thought we could actually look into proteins at that level; and you can actually edit the sequences of amino acids as well; those are like whoa, this is awesome."

**Views of scientific research in general?**

All six of the participants who answered this question reported that their view of scientific research was affected—ranging from one who said it was "an absolutely eye opener" and another who said "it explains how a particular study fits into the bigger picture, and the value it has, the contribution." Others expressed more particular, narrower gains ("It is very interesting but it also feels fulfilling to myself that I can do this" and "as an educator it's important to equip yourself with the recent or current trends" and "learned new things"). Finally, one participant said they learned that "scientific research is frustrating… then it requires me to read and read and read in a very limited time."

**Views of research in chemistry?**

Four of the participants felt it had affected their view of chemistry. One who didn't pointed out "not really because I teach chemistry." Others, though, indicated that now "I can control the variables I can show it to my kids" rather than relying on approximations on the internet. Another said, "I didn't know computation was out there. And some of my peers were doing that, and I didn't know anything about it before. I'm a hands-on kind of person. Talking to them I saw the importance of that as well." Another reported, "it opened a lot of ideas right now….:It opened my mind to look for other research. So, what I mean is. I'm now motivated to, to and to

find answers to those questions. Finally, one indicated that analytical chemistry was now quite different from what they were taught in school.

**View of UNM?**

Five of the participants outlined particular ways in which their view of UNM had changed.One commented that it is a very nice campus; and another that they learned about it from the administrators who came to lunch. One pointed out that "Now I think I'm very confident that I have a connection to UNM." Another pointed out that " I never thought that they have these interdisciplinary department here. I didn't realize that they have an interdisciplinary department wherein, you know, they actually apply all these different principles to zero in on the common ground. I'm very surprised and lucky to know that, because I can share it more to my kids with the students." Finally, one said that, to their surprise, they "saw some really cool things at UNM that made her know it's friendly, has rethought use of space outdoors, to study, to sit, not just one concrete slab." They now think it's an "Excellent place to go."

**View of UNM's CCB Department?**

Five of the participants pointed to changes in their views of the CCB Department. These ranged from "Yes, can ask for access to equipment for students" to particular interdisciplinary connections: "Protein is a biomolecule crucial for biological processes, but then their best fit is dependent on energy, and that's physics; their connections, the formation of these intermolecular bonds is chemistry right; so yeah I mean, it seems to me after this, of course, that those three cannot be separated." One participant noted that "Faculty and staff work very hard; lots of passion; high expectations for rigor in science" and another commented that "We did get the department chair. So we did talk with him. We saw that there was a lot of remodeling happening… we did get a tour of what's going to happen. There was not too much interacting because I guess it's the summer and a lot of people are not on campus. But yeah, I got some exposure to it." Finally one summarized that CCB is "Making strides to help undergrads succeed in chemistry in undergrad intro and supports for students who are struggling; glad they have that." This teacher knows kids who avoid chemistry as an element in a degree program and feels that not being successful will not attract students.

**Do you expect to maintain ties with anyone you met in the program? How?**

All of the participants expect to maintain ties with people in the program. Six commented that they were planning/expecting to stay in touch with the PI on their project and/or members of the lab team. Some had specific plans to continue the collaboration or develop it. Four also mentioned that they expected to maintain ties to other ROSE Scholars. One said, "It's probably like 40 to 50 teachers from across the state [who do state PD programs, and] know each other, so everybody kind of knows each other. I knew three [in the program].

**Would you recommend this program to others?**

All of the participants said, yes, though two qualified their responses by saying: Yes "I think it has to be a teacher that is willing to come in and know that, you know, they need to ask questions. They need to go into it knowing you might not know it and that's all right. But it's

teachers that are willing to maybe put in a little extra effort" and "I would be really selective who I recommend it to. Uh huh. I would just recommend it to everybody because I kind of think that, I have been at trainings where one person-- like kind of a bad apple fall soff the apple cart and disrupts the whole thing. So that's kind of a hard thing to weigh, and that's why it's just really important to have really clear guidelines about what's expected."

Many were, though, unreservedly enthusiastic, one hoping to encourage a junior colleague to attend and another reporting, "I'm going in person tomorrow to my school and I'm sure they're gonna be asking, well, all throughout the four weeks that I was up there, my colleagues in my department from my high school were texting me: How's it going? So most definitely they already have the interest because they know that I don't just participate in anything, so when I actually do participate, it's like, oh, what are you doing, what do you think, what's going on."

**Are you interested in participating in the ROSE program in the future?**

All 8 of the 2021 participants would like to participate again.

**Are you interested in participating in other research projects?**

About half indicated they had a strong preference to repeat their project from this summer, with reasons like, "I really want to gain more understanding with this field first before I jump into something else," "for reasons of continuity," and "I'd love to see what's going on—to see the progress after a whole year." Others were definitely also interested in experiences in new projects ("for the sake of learning more, you know, years of research on a different topic. That would be wonderful to work on a different field. That way you can also, you know, open another, another skill or another opportunity to learn your skill."). And still others expressed uncertainty ("maybe; would have to think about it").

**Is there anything that would be helpful in understanding the impact of the ROSE program on you that you'd like to add?**

Many of the participants volunteered further comments but they were so wide-ranging they are hard to summarize. For that reason, I have listed them here verbatim.

1) I hope the program continues.
2) Maybe we can have some kind of a, a panel or, you know, a panel discussion wherein the instructors or the PIs host, and give us suggestions on how we can present this material in the level of our students.
3) Stress to applicants that it's okay if they have no past experience
4) For future ROSE Scholars, maybe have a "for your information" kind of fact sheet, for logistics and expectations.
5) Would like to have as part of this schedule that all of the scholars will sit down and come up with, say a curriculum or lesson activity, like the actual.

6) A) Have teachers from past programs be “mentors” to new teachers in the program; B) Give the opportunity to have a few more slots for people that want to apply to the program, that don't have to [be housed] If people can commute in, and not have to go and get a hotel for a month, right, which is really expensive. I think that that's a good option to kind of give people, if they're able to drive in. So if they get waitlisted, open it up to the people that don’t have to be housed.

**Appendix D. Scholar interviews round 2 by Prof. A.J. Stewart**

**Report on Followup Interviews with ROSE Scholars**

Abigail J. Stewart, Professor of Psychology and Women's and Gender Studies
University of Michigan
October, 2021

Eight interviews with ROSE Scholars from the summer 2021 program were conducted from October 11-20, 2021. The open-ended interviews focused on recommendations for changes in the summer program, information about whether and how the program had informed the Scholars' fall teaching, and their interest in participating the program in the future.

**Evaluation and Recommendations**

Retrospective assessments of the program remained uniformly very strongly positive, with some Scholars unable to think of anything to change about the program. Suggestions for future changes at this vantage point included:

> --attention in the recruitment process to the issue of teacher anxiety about their own competence and suitability for the program. Some reported trying to recruit colleagues to the Program in the future and discovering reluctance due to a belief that they lacked foundational knowledge or skills necessary for the program;
> --more detailed preparation of admitted Scholars for the program in advance. This might take the form of post-acceptance conversations introducing the Scholars to the lab they would be in; and information about expectations for advance preparation and for participation in the program;
> --early on Scholars would like more clarity about the timeline for their participation, including some benchmarks to help them stay "on track" in the program;
> --increased discussion of approaches to science teaching, perhaps especially in the labs, both for the purpose of stimulating/enriching the Scholars' toolkit and their awareness of how science teaching is done at the University level, so they can support their students' preparation and expectations better;
> --inclusion of a prepared presentation for their school about the program that could also be adapted or given to their students; this could build on the presentation they gave this past summer, but it would be explicitly framed as something they could bring "home" and in which the audience was their own colleagues and students;
> --opportunities for brief exposure to other labs than the one they were assigned to, to broaden their knowledge and understanding of the field, and of the department's full range;
> --explicit information about how they, and their students, might follow the program up with questions about applying to UNM or the best preparation for the curriculum at UNM.

Several Scholars mentioned hoping that presentations could be arranged by their PIs and/or other members of their PI's labs. They would very much like these to be in person on campus, but--failing that--zoom presentations would be good as well. It was clear that they were uncertain about the necessary timeline for arranging such visits, or the appropriateness of requesting them.

It would be helpful if this kind of visit were explicitly discussed during the summer program, and advice was given (perhaps even in writing) about how best to pursue such visits during the subsequent school year.

**Bringing the ROSE Program into the Scholars' Schools**

Several of the Scholars reported that they had presented about the summer program to their colleagues either school-wide or in other contexts. They felt that their reports were highly valued and they were seen as having had a productive and exciting summer. One said, "During our professional development training we had the in-service training, prior to the start….So I shared that PowerPoint, and I received a standing ovation." Many Scholars presented information about the program in their classes and reported a similar impact on the students.

Asked directly about whether and how what they did in the summer affected their teaching, Scholars uniformly reported that it definitely had direct implications. Some reported on consequences for their feelings about science and science teaching: "I got a chance to regain my passion and energy towards science." Others pointed to their increased confidence in their knowledge and their research skills. For example, one noted:

> I think even just being able to get in the labs gives you that confidence back in your content area. I think that's really important because I mean as teachers we get that ragged on thing: 'those that can do, those that can't, teach.' I always correct it by telling them you know those I can do but those that understand it, can teach it. You know if you truly don't understand it, you couldn't explain it to someone well, and we don't have highly qualified teachers because they can't explain it sometimes, so I think being in the lab is good.

Quite a few noted that they were much more able to answer their students' questions about "why do I need to know this?" and about both college in general and UNM in particular. One commented that the program afforded them a chance to think about their pedagogy:

> This experience got me to reflect: is what am I doing relevant to what's happening out there? Am I building that connection that's really making an impact on our students. You know, how disconnected am I from what's really happening? And not only the content, but maybe the delivery of my instruction to be a little bit different. It's given me a different insight. The different labs that I do…were geared towards the content. Right now I'm thinking about how to introduce some of the concepts that I learned over the summer. I can actually kind of mesh those two together so it's not just aligned with the content and what we have to do, but it actually is relevant to what I did this past summer, and how can I help them see what I saw--giving them my experience through the experimentation that we do, the practices that I learned… [I think about] how can this be supplemented with the articles-- publications that are current right now. Right. So just be thinking: the labs that I do are not just based on the textbooks and what we've been doing for numerous years, but make sure that it's relevant to current research and try to actually let them have life experience to get as passionate as I was….

This Scholar noted that students are impressed with

> the fact that [significant scientific research] is happening in New Mexico. That was kind of mind blowing to them, because they're not used to hearing--they don't see all the relevant contributions that for example UNM is making to society as a whole.

In addition to the gains for individual Scholars in passion, perspective and pedagogical reflection, many described specific content they brought from the summer program into their classes already (halfway through the fall term). One teacher recounted this new material that depended on learning a program (Chimera) in the summer program:

> I was able to show my students: this is how a protein looks and you can vary this to[another] view….And so I was able to show them that's a protein [using the ribbon model], and then so when they shift the view to the atom model they can see: oh, there's a lot of carbon. So, because life is carbon based, and a lot of kids were able to visualize that, now I have a better way of giving these kids a visualization of a protein or an enzyme which is a protein.

Another noted that in discussing instrumentation, because the ROSE program provided access to instruments they had never seen before, he was now able to describe precisely how the equipment worked, and had the effects described in the research: "I was able to explain it to them because I had a hands-on experience." Similarly, another Scholar indicated that "I integrated discussion of caffeine into our lessons of enzyme, when we talk about competitive in competitive inhibition. I was able to explain it to them because I had a hands-on experience."

Some Scholars felt they got ideas about how to teach complex concepts to their students by observing their PI's explanations for them! One reported:

> Teachers don't get a lot of advisement--getting some advisement was really nice because my professor provided a lot of great feedback, and was very open and provided a lot of a lot of different strategies for teaching them that were very different from my head. My professor probably does this without even thinking about it, but some of the ways that the professor teaches with motion was just really great. And it was really effective and I had never really thought of doing that. And when I did that in class--I actually did something kind of like this in class--and it really was an effective way of doing it and explaining something. So I thought that that was really great.

Another Scholar discussed the way he now—after the ROSE Program-- incorporates a focus on careful laboratory practices around measurement into content discussions:

> I'm dealing with properties of matter, and using density to explain intensive versus extensive properties, you know, doesn't matter what the shape was of the metal, because I gave them like different pieces of metal that are all copper and all brass and they should get the same densities and, and they're not you know. I made them do it with a caliper and then water displacement: which one's more accurate and which tool is more accurate, and so we spent a lot of time on measurements and numbers within chemistry. Our next

> unit will be into phase change and atomic structure, going into ions and isotopes and then continuing with bonding and chemical reactions.

This focus on measurement is something he feels builds their understanding of the centrality of accuracy and precision to scientific understanding.

One teacher combined thoughts about shifts in perspective with a focus on relevant content:

> In general ways I have brought into science class a deeper perspective on how scientists operate, how they use evidence to support their claims. I can talk more about what scientific research is like and how it works. In terms of COVID, I can discuss mask-wearing and how we know whether they are effective, as well as germ theories. I can now provide a more open-ended approach to thinking about phenomena and using scientific methods (instead of previous model of "lecture, lab, test").

**Interest in the Program**

All of the 2021 cohort expressed a desire to participate in the ROSE program again, some noting goals that went unfulfilled (one wanted to learn about lasers but the laser in that lab was "down" during the Program), or exposure to new material in the same or a different lab. Some also noted that it is important to recruit other teachers to the program, and that they would 'step back' to enable that.

Overall, it was clear that the ROSE Scholars used their summer experience to deepen, reinvigorate and enrich the way they thought about both their pedagogy and the content they were teaching. They valued it highly, as did their schools and the students they are teaching.