Research Opportunities for Science Educators

The ROSE Program: Annual Report for 2022

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Executive Summary

ROSE expanded in all respects in 2022, its second year of existence- the number of Scholars increased from 8 to 20, the number of PI mentors increased from 5 to 12, and the duration was extended from 4 weeks to 5. The NM PED provided stipends for all 20 Scholars, while UNM units provided dormitory housing, graduate student stipends, catering and miscellaneous expenses and logistical support. Scholars were recruited from across NM, with 2/3 teaching outside the Albuquerque metro area, while biology and engineering faculty joined the original core of chemistry faculty as research mentors. A website (UNMROSE.unm.edu) was created to publicize the program and recruit Scholars.

The on-campus research session ran from June 6 to July 8, with 12 of the Scholars staying in UNM dormitories. Projects included computational simulations, chemical synthesis and characterization, and organismal biology. Scholars presented their results to each other as posters which could be taken back to their classrooms for the academic year. In addition to the research aspect, Scholars participated in panel discussions with UNM faculty and staff on college application and preparation and attended a workshop on molecular visualization software they can use for teaching. The PI mentors reported good experiences for their research groups, with benefits including better communication and fresh perspectives on their science. The Scholars reported a high level of satisfaction (average 4.8 out of 5) with the research experience, and all (100%) indicated they would recommend ROSE to other teachers.

Contact with Scholars continued during the academic year, although to variable degrees. A few classroom visits were arranged, and two virtual meetings of Scholars. In the follow-up survey in October 2022, Scholars indicated that the ROSE experience had improved their knowledge and confidence in the classroom (90%), that they used examples from their research in teaching (80%), and that they used research tools including software into their lesson plans.

Priorities for the coming year include establishing an ongoing funding model, improving Scholar recruiting procedures, expanding ‘cross-talk’ and networking across research groups, enhancing academic year connections and communications and developing longer-term methods to evaluate program impact on teachers.

I. Program Motivation and Overview

The ROSE Program aims to energize and enhance the teaching of high school science in New Mexico by leveraging the research resources of the University of New Mexico (UNM) and the educational resources of the State of New Mexico Public Education Department (PED). High school science teachers (ROSE Scholars) join ongoing projects for "hands on" participation in discovery-based research and bring their new ideas, tools and enthusiasm back to their classrooms. Teachers are selected based on the underrepresented minority (URM) student populations of their schools and their own scientific interests and background. Over the next several years we expect to build a vibrant statewide community of ROSE Scholars and UNM faculty, facilitating ongoing communication and sharing of educational and scientific resources.

Benefits

To New Mexico schools: ROSE will improve the quality of science education by allowing educators to refresh their knowledge and develop new skills while gaining appreciation for and inspiration from current scientific research.

To UNM: ROSE will help recruit well-prepared STEM students by familiarizing their teachers with our faculty, laboratories and research opportunities.

To the national scientific enterprise: ROSE will increase the number of URM college applicants in STEM disciplines while aiding and publicizing funded research projects.

Overview

Following a successful pilot program in 2021, the ROSE organizers (Profs. Rack, Cabaniss and Atlas) decided to expand the summer research from 8 to ~20 Scholars and from 4 weeks to 5 weeks in duration. Expanding the number of Scholars required that the assessment mechanism change from individual interviews to online surveys, and Prof. Cari Hushman from Educational Psychology (in the College of Education and Human Sciences, CoEHS) joined the organizing group as the assessment specialist. Prof. Sherman Garver of CCB also joined the organizing team (now 5 people) after serving as a faculty mentor.

Resource commitments were obtained in the Fall semester from a variety of sources. NM PED agreed to provide Scholar stipends on a one-time basis. Various UNM units (OVPR, AA, CA&S) agreed to cover graduate student mentor stipends, dormitory housing, and other on-campus expenses. The department of Chemistry and Chemical Biology (CCB) and the Interdisciplinary Science Cooperative (ISC) provided logistical support, including staff time and meeting space.

The program was promoted by establishing a website (https://UNMROSE.unm.edu), advertising in the PED's ***STEM Connect*** bi-weekly bulletin, and direct emails to summer 2021 Scholars and to superintendents across the state. After conversations with the New Mexico

Science Teachers Association (NMSTA), the program was also advertised on their website and the association contributed small honoraria for all the Scholars.

The research session ran for 5 weeks in June-July 2022, and had ~60 applicants, 20 of whom were selected and participated as Scholars (funded directly by NM PED). The faculty mentor pool expanded to include one biology and 4 SoE (School of Engineering) professors in addition to a core of 7 chemistry faculty. Cohort activities include weekly coffee breaks (Tuesdays) and lunches (Fridays) to allow for informal interactions and a weekly Friday afternoon cohort activity which varied from week to week, including a) a meeting with faculty and staff working with new student enrollment and support, b) CCB faculty who teaching freshman-level chemistry courses, c) a software tutorial on the Chimera molecular visualization program, and d) a 'brainstorming session' to discuss how ROSE and UNM more generally can assist science teachers. The session concluded with poster presentations by Scholars and closing remarks from UNM organizers, Shafiq Chaudhary from PED and representatives of NMSTA.

To promote a statewide network of Scholars who can share information and STEM education resources, ROSE maintained some communication with Scholars during the academic year. Emails to the Scholars were sent at regular intervals (~4-6 weeks) containing links to professional and educational resources and event notifications. All Scholars from 2021 and 2022 were invited to two Zoom meetings, which had modest attendance.

In anonymous online surveys, faculty PIs commented on the scholar's journey throughout the program and how it had impacted them and their lab, including contributions to the lab community, perspectives from outside the university, and modeling effective communication. The benefit of having a teacher's perspective in the lab was welcomed and increased communication within the research group (students, post-docs, Scholars, PIs). PIs commented on the sense of excitement, 'freshness' and motivation contributed by Scholars. The PIs all had wishes for more students, longer program time, and the hope for this program to continue. One PI's summary remark: "The overall program was very well managed as far as my experience was concerned. I hope continued opportunities with the ROSE program will occur!"

Scholars responded to a series of anonymous online surveys administered before during and after the summer session. The final survey was given in October and included questions about the impact of the ROSE experience on classroom teaching. Scholars reported a profound impact from the summer session, including more specific experiences and activities, greater confidence and 'comfort level' and better student engagement when discussing research. Scholars reported high satisfaction with the experience (4.80/5) and 100% of respondents to he final survey indicated they were very likely to recommend the ROSE program to other teachers and that they themselves would like to return. One Scholar remarked: "I am amazed by the number of times I have been able to connect a topic in class back to what I worked on during

ROSE." Another commented: "This is a wonderful program. I enjoyed not only the lab experience but also networking with other teachers. Thank you very much for this experience."

II. Publicity and website

An attractive and useful website helps to establish program 'legitimacy' and provides a convenient introduction to the program for potential Scholars, mentors, and others. The website was launched in early Fall 2021 at https://UNMROSE.unm.edu (the name ROSE.unm.edu was unavailable). Susan Atlas (ROSE webmaster) and Leanne Yanabu (CA&S web support) based the site on the Arts and Sciences template with pages for program description, the application process, mentor research projects, FAQs and acknowledgements. Pages describing the summer schedule and listing Scholars were added in 2022, along with a link to the application form (designed and overseen by Shafiq Chaudhary at NM PED).

Advertising for the Summer 2022 session used a variety of online mechanisms. The first advertisements ran in the PED's STEM Connect newsletter March 29 and April 6 (text for all ads can be found in Appendix A), providing a link to the online application. At the same time, emails were sent to the 2021 Scholars and to superintendents of all NM school districts (including charters). Although the best consideration date for applications was April 11, an additional advertisement was posted on the NMSTA website at about that date.

In retrospect, three issues were noted with the publicity campaign for recruiting Scholar applicants. First, both the NMSTA website and STEM Connect newsletter are 'opt-in' channels which teachers must sign up for; neither avenue would reach teachers directly unless they are already 'plugged in' to the science education community. Second, the applicant pool had a higher percentage of elementary school teachers than we had anticipated or desired; the advertising text should specifically mention middle and high school teachers who are the target audience. Third, the publicity and application link were distributed too late for some teachers, who had to make decisions about summer plans before they were accepted as Scholars; earlier publicity and an earlier best consideration date (late February or early March) would help minimize the number of teachers affected in this way.

III. Scholar Recruitment and Selection

The program solicits invitations for applications through the NM PED STEM Connect newsletter in February, and March. The deadline for acceptance of applications was April 2, 2022. The program advertisement is also sent directly to all NM Superintendents. Scholars are chosen primarily based upon their enrollment of Hispanic and Native American student populations and geography. Additional criteria include total students taught, planned and recent teaching history, and responses to questions in the application. All applicants receive an email from the program recognizing receipt of their application. All applicants receive either a confirmation email that they have been accepted into the program or have been declined. Initial acceptances were sent on April 17, 2022.

IV. Summer Research and Cohort Activities

The research session ran for 5 weeks in June-July 2022. PI mentors included seven faculty from CCB (Atlas, Chen, Garver, Gold, Habteyes, He, Rack), one from Biology (Salinas), three from CBE (Chemical and Biological Engineering: Bricker, Datye, Whitten) and one from CCEE (Civil, Construction and Environmental Engineering: Cerrato Corrales). Three of these groups (Atlas, Bricker, He) are purely computational, while six were partly or exclusively biological (Cerrato Corrales, Garver, He, Walker, Salinas, Whitten). The remaining PIs (Chen, Datye, Gold, Habteyes, Rack, perform principally experimental lab work without a substantial biological component. Specific projects and Scholar/mentor pairings are given in Appendix E.

The session began with dormitory check-in for out-of-town Scholars and a welcome reception at Draft and Table (in the Student Union) on Monday June 6. Program orientation for all Scholars took place on June 5, and included safety training, a campus tour and meetings with the faculty PIs. The summer session ended with poster presentations by the Scholars in the PAIS building, which included a catered lunch and closing comments by the UNM organizers, Shafiq Chaudhary (PED) and Margaret Showalter (NMSTA).

To encourage interactions among the Scholars and to broaden their exposure to UNM faculty and activities, a series of weekly activities was planned for the cohort of Scholars and all were encouraged to attend. These cohort activities included weekly coffee breaks (Tuesdays) and lunches (Fridays) to promote social interactions and informal exchanges of knowledge. A more formal activity was scheduled each Friday afternoon:

a) a panel discussion with UNM faculty and staff who work with new student enrollment, student support and financial aid;

b) presentations by CCB faculty who teach introductory chemistry lectures and labs;

c) a software tutorial given by students from Prof. He's research group, showing the Scholars how to display complex molecules like proteins on laptop computers with the Chimera molecular visualization program.

d) a 'brainstorming session' with the Scholars and ROSE organizers to discuss how ROSE and UNM more generally can assist science teachers.

V. Ongoing connections with Scholars

Following the research session, we attempted to maintain communications with the Scholars (2021 and 2022 cohorts) through periodic emails, Zoom meetings and class visits. Emails were sent regularly in the Fall semester, and less frequently in the Spring as ROSE shifted emphasis toward the 2023 summer research session. The emails typically centered on ROSE-related activities, but also mentioned other meetings and organizations like the NMSTA and American Chemical Society. Readership as measured by opening the emails was high (>80%), but responses were much lower (~10%). Two Zoom meetings were organized during

the Fall 2022 semester, and all Scholars were invited to attend. However, the agendas were fairly open, and while some of the Scholars seemed to appreciate the opportunity to re-connect after the summer, attendance was low and no real new ideas were put forward.

Scholars were encouraged to arrange class Zoom visits by UNM faculty and students. Jeff Rack zoomed in to Vandhana Ramachandran's chemistry class at Ruidoso High School, which included a virtual tour of his research lab space in Clark Hall. Chrysler Martinez invited Ben Garcia, a graduate student working with Irene Salinas, to virtually visit classes at Chief Manuelito Middle School in Gallup.

VI. Budget and funding requests

The 2022 research session was supported by non-recurring PED and UNM funds and by in-kind organizational support from UNM. NM PED paid the stipends of all 20 Scholars directly, $6,000 each for a total of $120,000. On-campus housing expenses were paid by UNM Academic Affairs, while $1000 payments for graduate students who worked closely with the Scholars ('technical mentors', as opposed to the PI mentors who direct the research group) were supplied by the OVPR. The OVPR also paid for the program assessment (graduate student stipend of $2000).

Obtaining commitments for one-time funding from multiple sources, even when successful, is time consuming and complicates planning. At the suggestion of the UNM VPR and Associate Provost Pamela Cheek as well as the PED, ROSE pursued the possibility of Research and Public Service Program funding from the UNM HED. The initial internal application form for FY24 funding was due in February 2022, and a more complete internal application was requested in May 2022. Over the summer, UNM RPSP categorical funds($100K for FY23) were committed to ROSE a teacher pipeline project. The FY24 request was also approved internally, which was now considered an expansion request ($218K in addition to the $100K in categorical funds for a total of $318K requested for FY24. The request was presented to the HED in October 2022; the application form and the slides for the presentation are included here in Appendix F. Had it been funded by the legislature, this expansion request would have supported 25 Scholars in summer 2024. However, neither the legislature nor the governor included the expansion request in their FY24 budgets recommended to the legislature, and the expansion was not funded.

ROSE organizers also met with Sarah Fair from UNM Foundation to explore foundation and donor funding possibilities. Unfortunately, no foundations were identified which were a good fit for ongoing 'core' funding of the program. We may want to explore foundation possibilities for one-time or trial projects affiliated with ROSE.

VII. Assessment Procedures and Outcomes

Program assessment was conducted with the use of surveys put together through Microsoft OneDrive Forms. The first 'welcome survey' was sent to scholars in the days before they started. Reminders were sent once on the day before the program started and then on the first day of the program. The survey had 17 responses. The welcome survey covered communication from the program, recruitment, expectations, self-efficacy about science and being a teaching. A second survey was sent during the middle of the program. The 'mid-point survey' was sent to scholars and PIs as a short and quick check in. There were only three questions about experiences so far, suggestions for improvement, and communication going forward; there were 15 responses from the scholars and 9 from the PIs. The third survey was the 'end survey' and given to the scholars and PIs at the end of the program. The end survey had 19 scholar responses and covered how the scholars felt about their understanding of research, feedback about the ROSE program, and if this impacted how they will teach. The PI survey had 10 responses and covered feedback about the program, successes and challenges from the experience, and suggestions for the future. Lastly, the scholars received a fourth survey sent in the begging of November, a couple months after the program ended. This 'follow up' survey had 10 responses and covered items similar to the last three surveys and focused on what has changed in their teachings.

Items in these surveys were written to address goals of the program, assess impact of changes made from prior years, and to gather suggestions for next year. Specific goals can be found in Appendix H. The detailed evaluation can be found in Appendix I (ROSE scholars) and J (PIs). Overall, teachers had a favorable experience which enhanced their perceptions of UNM, increased their knowledge of research, enhanced their self-efficacy for science teaching and re-motivated them for the upcoming school year. The largest reported impact on their teaching included being more confident in giving feedback on research, the examples used during class, and having their research posters in the classroom. There was little reported change from the final survey and follow up survey for teachers. For PIs, they report an overall positive experience for the lab team including positive impacts in how their graduate students communicate about science, having a different perspective on the team, and overall better understanding of science education in New Mexico.

Overall suggestions for improvement includes doing more 'onboarding' before the actual experience happens, doing more of the safety training online, and better preparation (reading/knowledge) regarding the project before being on campus. Accessing keys and the state of the dormitories are persistent challenges.

VIII. Future Considerations and Suggested Improvements

- Establish a stable funding model to improve planning and assure program continuation.
- Expand and improve recruitment procedures to reach more potential Scholars and to allow sufficient planning time for Scholars and PIs.
- Recruit additional faculty PIs, especially outside of CCB.
- Allow Scholars to learn more about research in other lab groups before the final presentations.
- Continue to grow connections with Scholars during the academic year
- Explore opportunities for equipment/activities/lessons Scholars can take back to their classrooms.
- Connect with the COEHS's data team to explore ways to access data through the state dashboard and college's data sharing agreement to assess ROSE impact on teacher retention.

Acknowledgements

ROSE gratefully recognizes the organizational and funding contributions of New Mexico Public Education department especially Shafiq Chaudhary and Jacqueline Costales.

Many different units at UNM contributed to the ROSE program, including:

- the Office of the Vice President for Research (Ellen Fisher), graduate student payments
- Academic Affairs (Pamela Cheek, Dan Garcia), on-campus housing and panel discussion
- College of Arts and Sciences (Arash Mafi, interim Dean), logistics and incidental expense via the Interdisciplinary Science Cooperative (Jeff Rack, Director)
- The Department of Chemistry and Chemical Biology (Jeremy Edwards, chair), incidental expenses and logistical support.