Syracuse University
School of Education

PARADIM Research Experiences for Undergrads (REU)

August 2023

PARADIM: Research Experience for Undergraduates (REU)
2023

A Research and Evaluation Project of
The Office of Professional Research & Development
School of Education at Syracuse University

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Introduction

Research Experiences for Undergraduates (REU)

PARADIM, the *Platform for the Accelerated Realization, Analysis, and Discovery of Interface Materials*, is a national user facility at Cornell dedicated to the discovery and fabrication of materials with unprecedented properties that do not exist in nature. Each year PARADIM invites selected interns interested in growing new materials targeted by PARADIM users and/or improving the techniques used to grow, characterize, and provide theoretical guidance leading to their discovery and optimization.

The PARADIM REU Program is designed to give undergraduate students an introductory research experience in the growth, structural/electrical characterization, or use of first-principles theory relevant to thin films of transition metal oxides or chalcogenides currently being researched as next generation electronic materials within PARADIM.

This year's REU sought interns not only interested in growing new materials, but also those interested in optimizing and improving the equipment used to grow and characterize them. Molecular beam epitaxy (MBE) and MOCVD (metal-organic chemical vapor deposition) are state-of-the-art thin film growth techniques with atomic precision, and PARADIM offers unique systems with world class capability. Laser Pedestal and High Pressure Optical Floating Zone (FZ) are world leading bulk crystal growth capabilities. PARADIM also houses the world's highest resolution electron microscope which allows you to probe materials atom-by-atom. Electronic and structural properties are characterized at PARADIM using angle-resolved photoemission spectroscopy (ARPES) and x-ray diffraction (XRD). PARADIM is also spearheading new data-rich Artificial Intelligence/Machine Learning techniques to improve materials discovery.

Projects are scaled to be challenging yet achievable within the program's time frame, from early June through mid-August. This REU program culminates with a convocation held jointly with the REU students from Johns Hopkins University where each intern gives a final presentation. Interns also write a two-page report, due at the end of the program, that will be posted on the PARADIM website.

Methodology

The Evaluation Team employed a Developmental Evaluation Methodology (Patton, 2011) in studying the program implementation and impact. Developmental Evaluation[1] focuses on collecting both qualitative and quantitative data applied to formative and summative study. Formative evaluation examined fidelity of the program's implementation (degree to which what was done met criteria of intent and professional standards of practice); areas for continuous improvement; and practices worthy of replication in REU programs locally and more broadly. Summative evaluation sought data providing evidence of program outcomes and impact, as well as for making a case for continuing REU program sustainability.

The data collected by the Team focused on four information sources:

1. Document Review: Examination of program and demographic data from PARADIM website and REU management and operations documents
2. Mid-point Survey: Assess mentor/mentee relationship as it relates to project productivity
3. Presentation Observations: Dual evaluator observations of a sampling of intern presentations, employing a multi-criteria assessment instrument
4. Intern Survey: Post-program survey seeking intern information related to program quality (lectures, mentoring, research, presentation, virtual delivery)

After all data were compiled and analyzed, a REU Final Report is drafted to address the needs and interests of key stakeholders (funder, PARADIM leadership, REU planners) and to provide findings and recommendations to inform further program planning, i.e., what to maintain, what to revise, what to eliminate.

[1] Patton, M.Q. (2011). *Developmental Evaluation: Applying Complexity Concepts to Enhance Innovation and Use.* New York: The Guilford Press

FINDINGS (See Appendix for complete survey)

Student Perceptions

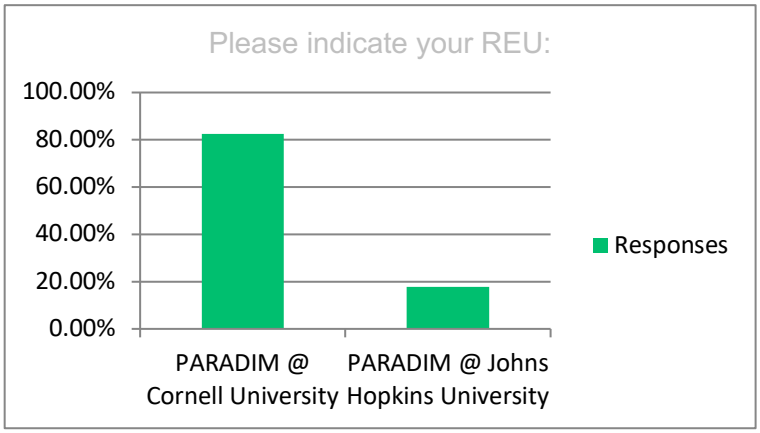
Following the conclusion of the 2023 REU program, the Evaluation Team administered a post-survey to all interns. The cohort of 18 completing the program (13 Cornell REU completed the program; 4 Johns-Hopkins REU completed the program; 1 Clark Atlanta University Summer Research Explorers Program (SREP) completed the program) represented (15) universities:

Cornell REU 2023	**Major/College**	**Mentor**
Henry Bowman	Physics and Mathematics, Carleton College	Cameron Gorsak
Ishani Cheshire	Physics and Astrophysics, University of California at Berkley	Harikrishnan Kunhikrishnan Premakumari
Yufan Feng	Chemical Engineering/Material Science Engineering, Cornell University	Qi Song
Casey Kim	Materials Science Engineering, Cornell University	Jinkwon Kim
Tomas Kraay	Materials Science Engineering, Cornell University	Anna Park
Adriana Lavopa	Materials Science Engineering, University of Florida	Evan Li
Kira Martina	Materials Science Engineering, University of Illinois at Urbana-Champaign	Jacob Steele
Ian Mercer	Material Science Engineering, North Carolina State University	Neha Wadehra
Pheandria (PJ) Miller	Chemistry, Texas A&M University	Jinkwon Kim
Luke Omodt	Physics, Augsburg University	Maya Ramesh
Nicholas Redwing	Materials Science Engineering, Pennsylvania State University	Nicholas Parker
Hayley Ruddick	Materials Science Engineering, Arizona State University – Tempe	Tobias Schwaigert
Yongwen Zheng	Math and Physics, University of Michigan	Steven Zeltmann
John's Hopkins REU 2023	**Major/College**	**Mentor**
Jayson Johnson	Mechanical Engineering, Howard University	Thomas Whoriskey
Aviana Judd	Materials Engineering, University of Kentucky	Satya Kushwaha
Ganon Murray	Chemistry, Earlham College	David Elbert & Brandon Wilfong
Nathan Song	Physics, Mathematics, University of California at Berkley	
Clark Atlanta University – Summer Research Explorers Program (SREP) 2023	**Major/College**	**Mentor**
Selena Coye	Physics, Clark Atlanta University	Katie Azizie (Cornell)

REU Affiliation

Students were asked to indicate which REU school they worked with during the program. Based on 17/18 responses the data indicate that 82% of students were working with Cornell University and 18% of students worked with John Hopkins University.

Figure 1. Student REU Affiliation

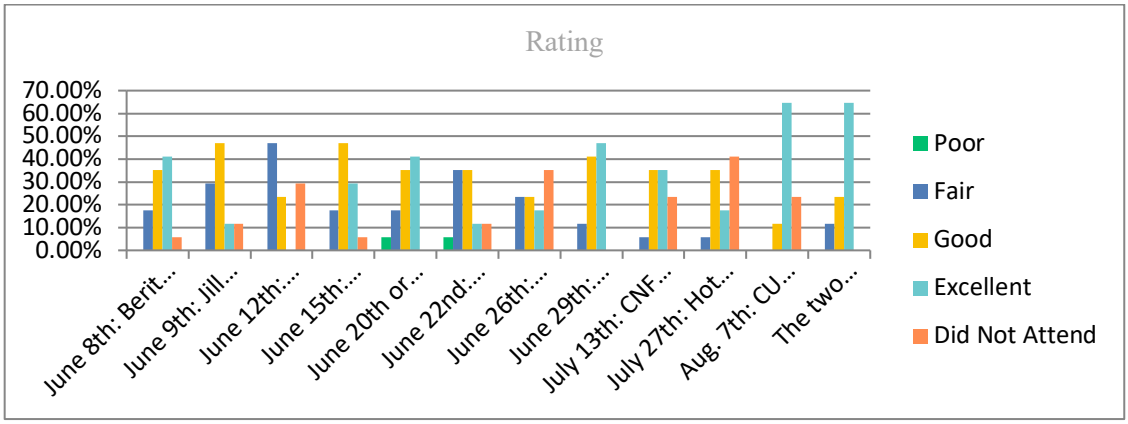


Student Experience Assessment

The survey administered asked the participants to respond to a number of questions rating their experience with the REU program and to what degree the experience will impact their choices going forward. 17 of the 18 participants responded to this survey.

Participants were asked to rate their experiences with the lectures, training sessions, and activities as well as their overall REU experience as shown in Figure 2. Of the 17 respondents, data show that 0 skipped this question. The data indicate that 32% of those responding rated the experiences with the lectures, training sessions and activities and their overall REU experience as "excellent". A further 33% rated the experience as "good," with 19% rating it as "fair" and 0% rating it as "poor". Additionally, the data show that 16% responded "did not attend".

Figure 2. Student Experience Assessment



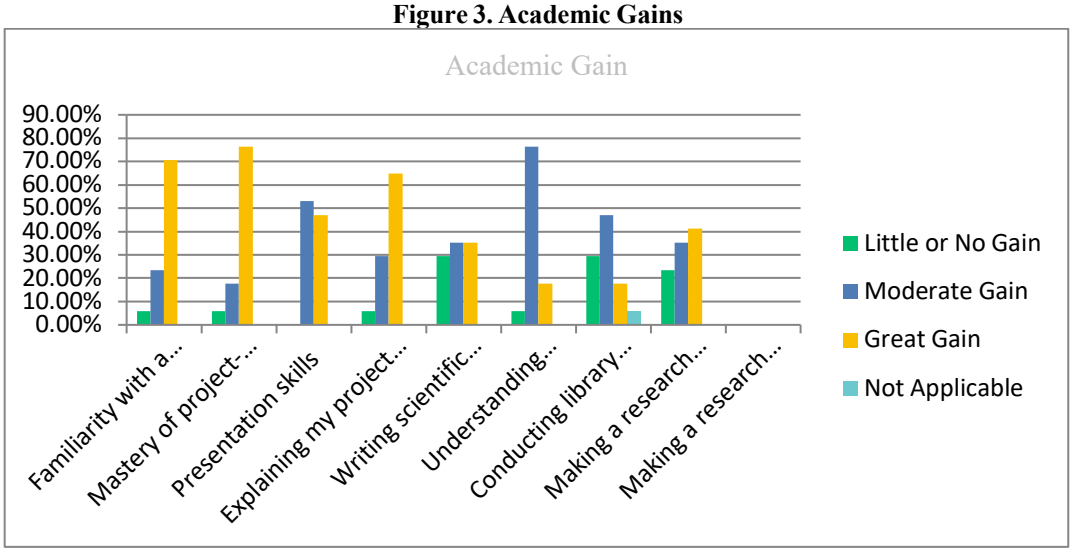
Full List of Lectures, Training Sessions, and Activities in Figure 2

June 8th: Berit Goodge, Brendan Faeth, Nick Ng, Drake Niedzielski, The Four Corners of PARADIM
June 9th: Jill Powell, Library Science
June 12th: Orientation Safety Training (Zoom)
June 15th: Workshop on Research Ethics and Responsible Conduct
June 20th or 27th: Prof. Julie Nucci, Jim Overhiser, Science communications and Presentation skills workshop
June 22nd: Chirality Magic from Magic Sized Clusters
June 26th: Lynn Vincent, Collaboration Workshop
June 29th: Steve Zeltmann, Hot Materials Talk
July 13th: CNF Clean Room Tour
July 27th: Hot Materials Talk
Aug. 7th: CU Synchrotron Tour (Wilson Lab)
The two slide/presentation preview sessions with Jim Overhiser

Academic Gains

Additionally, participants were asked to rate the academic gains related to the research techniques, as well as the skills connected to their abilities to provide the information to people outside their specific area of focus. Of the 17 respondents to the survey, 17 responded to this question with 0 reported as "skipped". Participants rated the academic gains with an average of 46% rating their academic gains as "great gains", an additional 40% rating their gains as "moderate gain", and 13% rating "little or no gain". Finally, an average of 1% of respondents indicate "not applicable" (1 respondent indicating that the sub section "conducting library database searches" was "not applicable").

Figure 3. Academic Gains

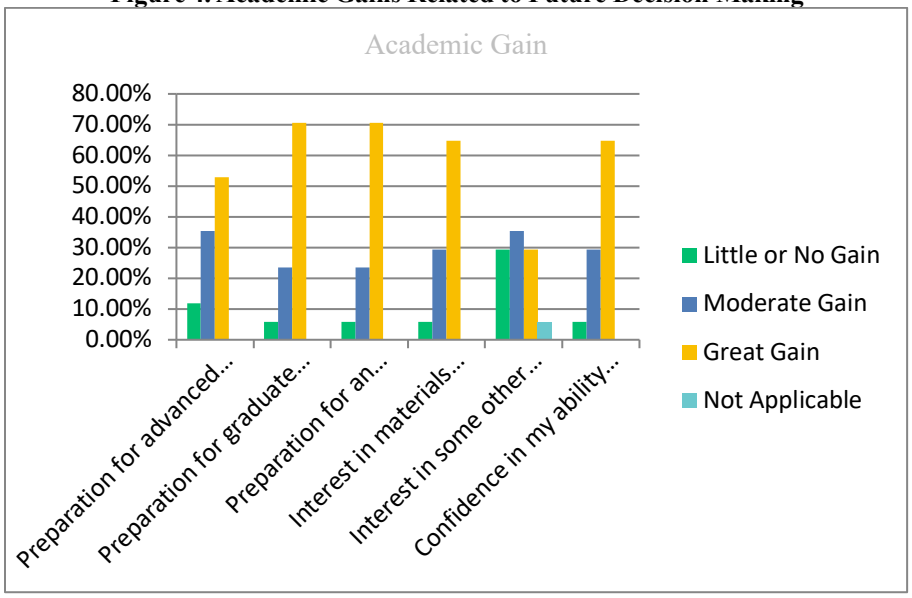


Additional Academic Gains (related to future planning)

The survey provided the participants the opportunity to rate additional academic gains in areas related to their preparation for future choices and interest in the materials they researched, interest in other scientific research, as well as their confidence in their ability to contribute to science.

As with previous questions, of the 17 respondents, there was 0 who skipped this question. The data in Figure 4 indicate that roughly 1% found this question to be "not applicable", while 59% indicated "great gain", 29% responded "moderate gain", and 11% reported "little or no gain".

Figure 4. Academic Gains Related to Future Decision Making



Following up on the questions regarding gains from the program, participants were asked to provide additional information of gains that were not addressed in previous questions. The participants were particularly asked to further elaborate on any "little or no gain" responses they provided. This question was responded to by 9 of the 17 participants with 8 skipping the question.

Figure 5. Additional Information Provided Regarding Gain (Direct Student Responses & Summary)

Direct Participant Responses:

Responses
All gain areas that I were not already strong in made "Great Gain", while areas that I believed I was already strong in had improvements, but not large ones, hence "Moderate Gain"
I didn't think that I gained much skill in understanding journal articles.
Would really like in the future if one of the hot talks was about writing our reports, we went over the poster and presentation but never the report
This experience was a strong affirmation of my aspirations to pursue a career in materials research.

I would say I made significant gains in every area in which I spent significant time. Pretty much across the board, the more time I put into something, the more gain I got out
I learned a lot about just about everything. This experience really grew my confidence for future grad school possibilities.
This mostly pertains to my mentor and the poor quality of mentorship I found as the summer progressed. I had high hopes for Cornell and was severely disappointed when I was assigned the busywork of the project. I was not present for a majority of the MBE growth - largely due to arriving and having a handful of samples that needed to be measured. This was not what was frustrating - the lack of communication of WHY we needed those datasets in addition to HOW he wanted them precisely measured was commonly missed. Early in the summer I was encouraged to ask questions and unfortunately the first round of explanations were insufficient and the papers were long and very dense, so upon asking again I found my "mentor" telling me he had already explained such things to me. This was frustrating to me and ended up really taking away from the project - I was now unmotivated, inexperienced and quite demoralized very early on into the summer. Unfortunately this did not improve as we began working on the project halfway through the summer - he would not provide me updates on growth parameters, experimental logic when changes were made, or on any work/data he took when I was not present in the lab. Fortunately this was not my first laboratory experience but I think had I not been familiar with research beforehand I would have left PARADIM and Cornell very disappointed and unlikely to pursue research later on.
We learned about how to use the library databases during a presentation, but I did not use a database at any point this summer.
I gained a lot in all areas mentioned, and I also developed greatly in navigating both the successes and failures in the research process.

Summary of Survey Responses

Gains:

- Confidence in unfamiliar areas of project
- Creating an excitement around research
    - Led to expanded interest in chosen field
    - May lead to different graduate choices
- Expanded research techniques – both successes and struggles
- Focus on support with final presentation including professional presentation slides, posters, and paper

Considerations for Improvement:

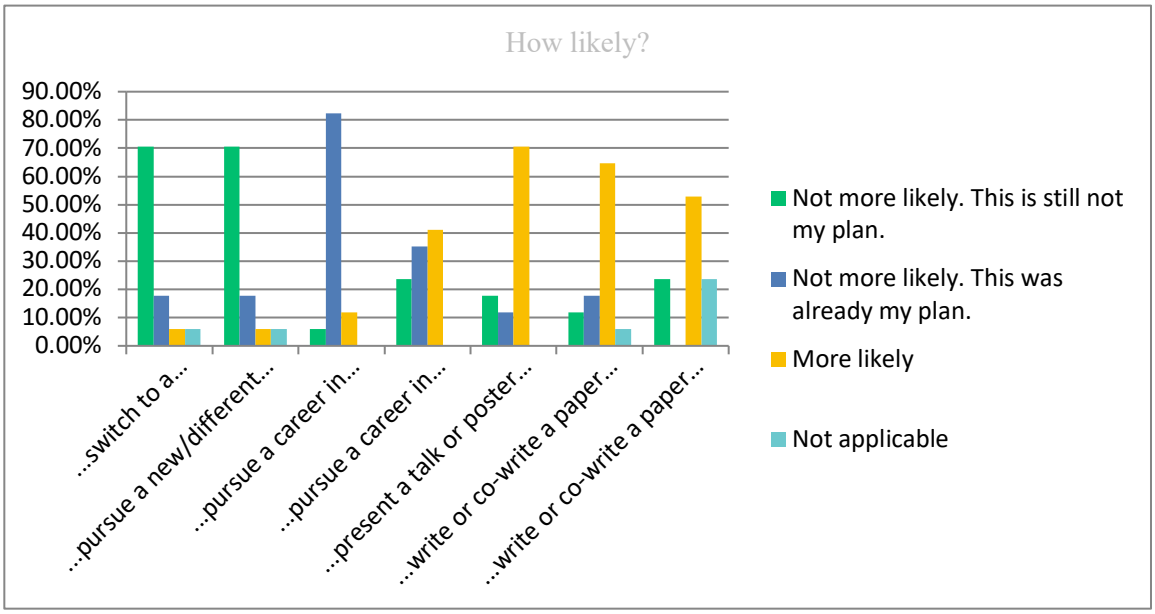
- Further experience and guidance in library research and use of journal articles
    - Learning more about how to use previous research literature to support current research
- Further gains desired in familiar aspects of project
- Networking
- Learning in areas not used in project should be connected better to project needs
- Consistency of mentoring support

REU Impact on Possible Future Academic Choices

Following up on questions regarding gains made through the program, participants were asked to indicate how the REU research experience impacted possible considerations for future choices in areas such as college, career, conference participation, and/or publishing academic work.

Of those participating in the survey, 17 responded to this question and 0 individuals skipped the question. Figure 6 shows that the overall data indicate that 36% of respondents indicate they are "more likely", 26% state "Not more likely. This was already my plan", while 32% respond"Not more likely. This is still not my plan". Of respondents 6% responded "not applicable".

Figure 6. REU Impact on Future Choices



Participant Likelihood to Present, Publish, or Apply for Awards/Scholarships

Figure 7 represents the data regarding the participants' responses when asked to provide additional information if they reported being likely to present, publish, or apply for awards/scholarships based on the research they conducted in the program. As with the previous question of the 17 total respondents, 12 provided responses. However, of the 17 responses provided, 5 stated "N/A" and did not provide any additional information. Based on Figure 7, participants noted no indication of plans to apply for awards or scholarships.

Figure 7. Likelihood to Present, Publish, or Apply for Awards/Scholarships Based on REU Experience

Direct Participant Responses:

Responses
I prepared a poster and would love to present it.
My contribution to the research my mentor and I did during the summer is most likely to be used in a future paper, which I will most likely credit when applying to future awards/scholarships.
This program raised my confidence and gave me new opportunities.
n/a
I gain greater academic abilities hence I have greater potential to do so.
Dependent on results this fall, some publications may be possible.
I will be a co-author on one of the graduate students paper.
I had never considered it to be a possibility before this experience, but now I feel like I have more confidence and experience to pursue publication.
I am working with my grad student mentor, PI, and a few other coauthors to write up a paper summarizing my summer project. Some further work may be required to finish this paper, but it will largely be based on my work this summer.
n/a
n/a
I was lucky enough to have the ability to work on two projects that expect to publish relatively soon. I also felt my contributions were more than simply doing what I was told to do; I contributed ideas and direction as well.

I was able to conduct my own original research, which I will hopefully be able to present and/or publish.
n/a
Each fall some undergraduate students at my university go to the Material Science & Technology conference, if there are open spots I may present my work from the summer at the undergraduate poster or speaking event.
I would like to present my summer research at my university's Fall undergraduate research symposium. I am also considering applying to present at a regional poster session for undergraduate researchers.
na

Summary of Survey Responses

Gains:

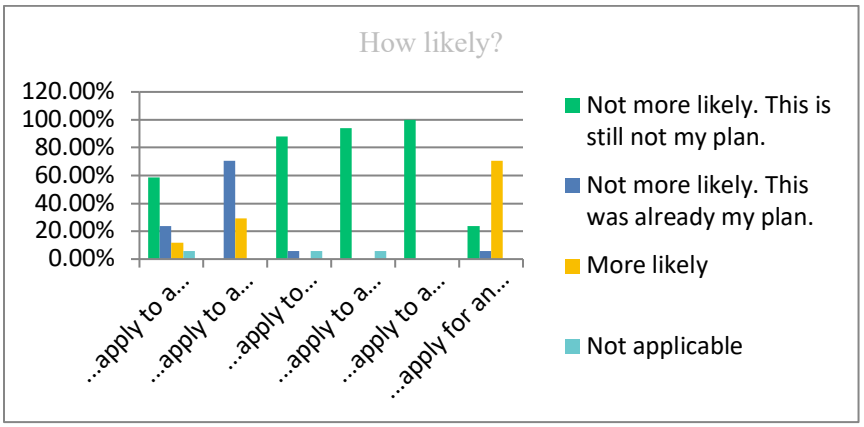
- Increased likelihood of publishing academic work
  - Individually or with mentor
- Use of presentation skills in future
  - Poster presentations
- Desire to further present research

Considerations for Improvement:

- Uncertainty around possible presentation of research

Figure 8 shows of those participating in the survey, 17 responded to this question and 0 individuals skipped the question. The overall data indicate that 18% of respondents indicate they are "more likely", 18% state "Not more likely. This was already my plan", while 61% responded "Not more likely. This is still not my plan". Of respondents 3% responded "not applicable".

Figure 8. Participant Responses Regarding Planning for Career or Advanced Study



REU Impact on Participant Career or Graduate School Planning

In follow up to the previous question, participants were asked to provide personal responses in their own words regarding the influence the REU experience had on their thinking about future career or graduate school plans (or not). Of the 17 individuals participating in the survey 17 provided responses with 0 choosing not to respond.

Figure 9. Participant Responses Regarding Planning for Career or Advanced Study

Direct Participant Responses:

Responses
I would like to pursue a PhD degree in the pursue in the field of MSE.
My REU experience did not change much about whether or not I went to graduate school, as I had already decided that I wanted to beforehand. However, it made me think more about the specific fields I'd like to work in, what I'd like to do, and what being a graduate student actually involves.
It opened me up to the possibility of material science as a career path for me.
I feel even more confident that this area of research is what I want to continue doing.
Give me a sense of real research
This experience introduced me to great mentors, an amazing project, and exposed me to new people and grew my skills as a researcher and communicator. Working with people in the direct area of research I am interested in gave me confidence in applying to and contributing to graduate schools in the near future, and confirmed my interest in a higher education.
It helped me get an understanding of what I would be doing in grad school
My REU experience has affirmed my interest in a materials-related research career. However, I am still not sure if I want to pursue an experimental or computational specialty.
My REU experience only strengthened my confidence in my original plan to pursue a PhD in materials science or a closely related field. Although I was already planning on this course of action, my REU gave me reassurance that this is what I want to do
It solidified my liking for materials science and would like to continue studying
Made me consider material science as a career
It grew my confidence in my ability to succeed in a career in research. It also taught me new things that gave me new passions.
I really enjoyed my research experience this summer. I had already planned to pursue a PhD, but this experience gave me more of an idea of what it will be like.
Fortunately this was not my first laboratory experience so I will still apply for PhD programs elsewhere but I think had I not been familiar with research beforehand I would have left PARADIM and Cornell very disappointed and unlikely to pursue research later on.
I was already planning to apply to PhD programs in Material Science and Engineering. This REU experience helped me feel more confident in that decision and explore a new research topic I may pursue in grad school.
This REU gave me more confidence in my plans to pursue a graduate degree in materials science and engineering. I may not remain in the field of thin film growth, but I have come to enjoy materials characterization, and I could see myself pursuing a graduate degree in nanomaterials.
The REU has made me aware of the importance of carefully choosing whose lab you work in and how the people there can help or hinder you.

Summary of Survey Responses

Gains:

- Increased confidence
- Solidified planning for future planning
    - Improved understanding of personal goals
    - Increased clarity regarding field of focus
        - Value of hands on experiences
    - What to consider in an advanced program of study
        - What to ask when evaluating a program for personal benefits
- Provided experience to support future study
    - Increased ambition within chosen fields

- Networking
- Broadened knowledge of overall fields
  - Laboratory variety
  - Career Pathways

Considerations for Improvement:

- No areas for improvement highlighted by participants, with exception of one student very unsatisfied with the program (could be based on early negative opinion of mentor support)

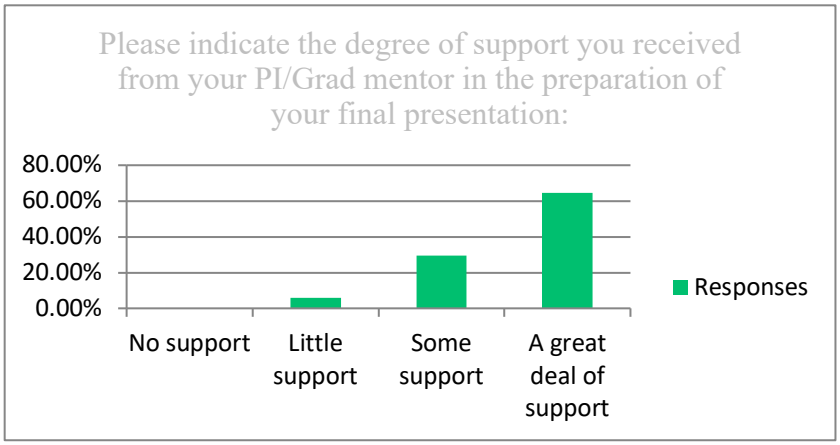
Mentorship Assessment

Students were asked to provide feedback regarding their perceptions of the experience with their mentors in the following areas as shown in Figure 10:

1. Support in preparation of final presentations
2. The importance of the mentor to the success of the REU experience
3. The degree the mentor influenced their future plans

Students reported at least some support in preparing for their final presentations, with 65% reporting "a great deal of support", 29% reporting "some support" and 6% reporting "little support". Of the 17 participants responding to the survey, all 17 provided responses to this question.

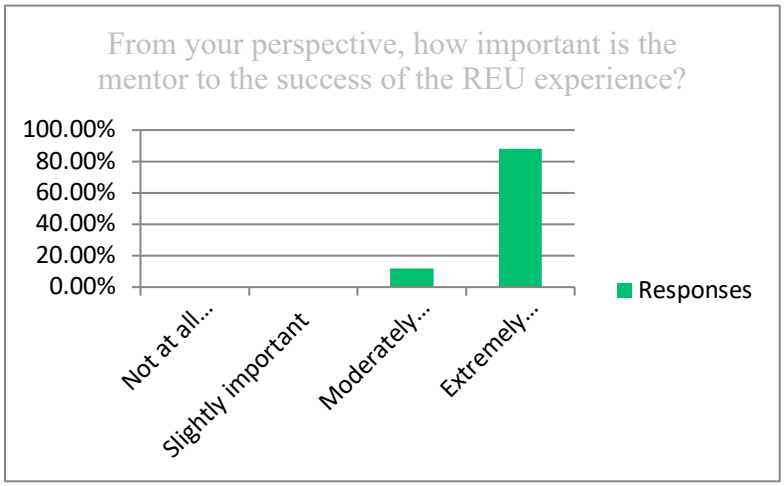
Figure 10. Mentor Support with Final Presentation



Student Perspectives Regarding Mentor Importance

In evaluating the importance of the mentor to the success of the REU experience from their own perspectives, Figure 11 shows that students reported at least a moderate importance of the mentor, with 88% responding "extremely important" and 12% responding "moderately important". Again, all 17 participants provided responses with 0 skipping the question.

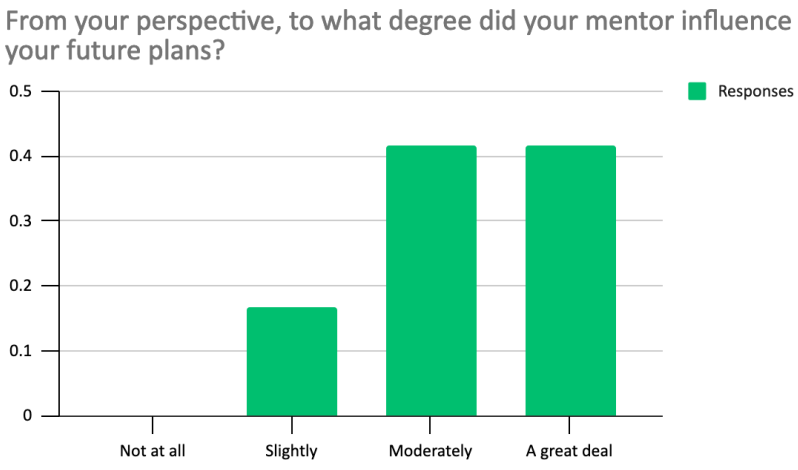
Figure 11. Importance of Mentor in REU Experience



Mentor Influence on Future Planning

Participants were then asked to rate the degree to which their mentor influenced their future plans. All respondents provided the degree to which their mentor influenced their future plans with 6% reporting "not at all", 23% reporting "slightly" influenced and 18% reporting "moderately" and 53% reporting "a great deal" respectively. Again, all 17 participants provided responses.

Figure 12. Mentor Influence on Participant Future Planning



Participants were provided the opportunity to elaborate on the mentor experiences in their own words. 12 participants provided additional comments with 5 participants skipping the question

Figure 13. Participant Responses Regarding Mentor Influence

Direct Participant Responses:

Responses
She guided me through the project by providing fruitful feedbacks and taught me important scientific concepts.
In my opinion, my mentor, Nick Parker, was an extremely great mentor. We did a lot of great work together with my project, and he was always letting me get hands-on experience, whether it was with the characterization equipment or the MBE. He also always took the time to explain concepts in detail to me when I was confused. When I was preparing for my presentation, he spent multiple hours helping me plan out the talk and making comments and feedback to my slides that I thought really helped the result. In the end, we did as much work as I thought we could possibly do in the timeframe that we had, and the only negative I had was that I could not stay longer to finish what we weren't able to get to.
My mentor was very present, and we met almost every day of the summer. I learned a lot from him because of it.
Neha is a great teacher and a great person, and both of those things impacted our work a lot.
My mentor can help me a lot but not always available.
Great support, great mentorship, and great communication. It was very helpful to have a mentor who took the initiative sometimes to arrange meetings, as I tend to get stuck on a problem and stubbornly hack at it. Access to a mentor who was open to undergraduate research and supportive of new students was invaluable.
My mentor was good about explaining things to me and helped me make my presentation.
My mentor took a supportive but hands-off approach that allowed for flexibility and personal discovery without feeling overwhelmed or confused. I had clear goals, but determining how to pursue them was left for me to explore. I believe that I learned much more this way then I would have with a more prescriptive approach, or with less guidance.
I couldn't find enough superlatives to describe my mentor! Cameron was fantastic. He provided guidance when I needed it, but also let me work on my project independently when I was capable. He was extremely nice and dependable throughout the entire process; I have nothing but positive things to say about him.
He was great.
I had a good experience and learned a lot from my mentor.
I had multiple mentors this summer, and they all were wonderful. They were very receptive on any questions I had. They were very welcoming, so I felt as if I was part of the lab. I can't say enough things about how great they were. They also gave valuable information on how to choose a grad school.
I collaborated well and was able to get advice from not only my mentor, but from many other members of the lab group.
Calling him a “mentor” is overly generous - it was more of a business transaction with very little guidance from him. I detailed this in a previous question.
I think my mentor did a good job training me on equipment and teaching me about the background of the project at the start of the summer. He was helpful whenever I had questions or needed help. It was also helpful to hear his perspective as he did this REU as an undergrad.
My mentor, Evan, was fantastic, I could not have asked for a better experience. His patience and willingness to explain every question, no matter how simple, greatly helped me, especially since I entered the program with little prior knowledge about electronic materials or oxides. His explanations were always excellent, his guidance helped me grow immensely, and I appreciated that he wanted to make this summer an enjoyable experience.

My mentor was always willing to help me in the lab or explain some concept; however, I felt that he was not the best at explaining these concepts or the purpose of my project in a way that I could understand. I was often frustrated by ending up more confused after I asked him for help. I also had a grad student mentor who was wonderful. She helped me with many of the machines I used and was there for anything else I needed. The only downside was that the projects she worked on were very different from mine, meaning she couldn't always explain some of the background concepts I was trying to understand.

Summary of Survey Responses

Gains:

- Present and hands on mentorship
- High quality support from mentor
    - Build confidence through a relatively hands off approach by mentor
        - Continued support even with hands off by mentor approach
        - Value of hands on experiences
        - High quality instruction of how to use necessary equipment as needed
- Provided growth opportunities for participants

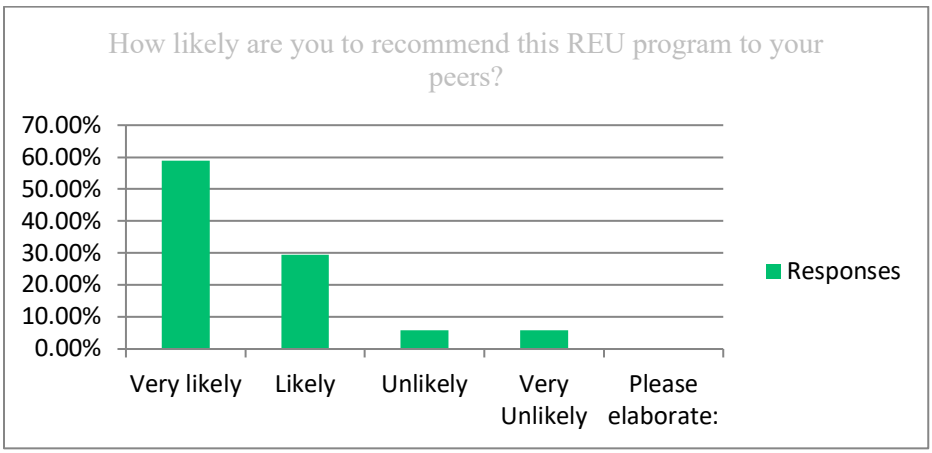
Considerations for Improvement:

- Feeling that the experience with mentor was a business transaction rather than guidance
- Clarity of some mentor explanations of complex material

REU Recommendations to Peers

In being asked about the likelihood of recommending the REU program to their peers, Figure 14 shows 17 participants provided responses that ranged from "very unlikely" to "very likely" and 0 participants skipped the question. Of those respondents providing responses, 59% stated they are "very likely" to recommend the program, 29% stated they were "likely", and 6% stated they were "unlikely" and an additional 6% stated "very unlikely" to recommend the program. Of the participants 0% chose to elaborate.

Figure 14. Participant Recommendation to Peers



In wrapping up the survey, Figure 15 data show the participants' direct responses when provided the opportunity to discuss, in their own words, the best aspects of the program and those areas that they believe are in need of improvement as well as an opportunity to provide any additional comments they wished. Of the 17 respondents participating in the survey, 17 responded to and 0 skipped the question

Figure 15. Participate Views on Best Aspects and Areas for Improvement

Direct Participant Responses:

Responses
I love the aspect of working with a PhD or postdoc and actually contribute to their work
I enjoyed the hands-off approach, especially since I had already done multiple REU programs and did not need too much support through multiple scheduled events/tutorial presentations. The equipment that I was able to work with was very impressive and made me better understand the Materials Science field of research.
I liked that the program was reasonably accessible even to non material science majors. I think that one of the aspects of the REU program most in need of improvement is that our cohort never really coalesced into a supportive group of peers. We mostly kept to ourselves. I think that if the program organizers organized more PARADIM REU-specific social events early on,or had us present our projects to each other to practice earlier in the summer, then this would not have happened. Furthermore, I think that in general the program could hold its students to a higher standard. In previous REU experiences, professors have held my work to a similar standard as their graduate students. This summer, however, I noticed that professors expected far less of us.
I love it all.
The research I'm conducting is very cool. However, the program is disorganized and information given is inconsistent. For instance, the program coordinator told us that all healthcare expenses at Cornell Health will be paid for. This fact was confirmed with several interns. But later the coordinator claimed it's only the insurance that the program is paying for and refuted he said otherwise.
The best aspects were the great mentor and overall focus on research. Compared to another REU I attended last year, the lack of nonessential / mandatory activities helped save time for research, and it really made the most of the 10 weeks that we had. I can't think of any improvements, except maybe some better communication rules for mentor-mentee relationships. My mentor was amazing, but from what I heard from my labmates a very small amount of mentors were unclear on their expectations and goals.
I liked how all Rey's were able to get together for hot talks and our meetings with Jim about our presentation. To improve I would say the first week there need to be more activities for us reu to get to know each other such as when the jhu people came we had pizza at the dorms.
The best aspects of the REU program were the opportunities to work on relevant, meaningful work with the support of the entire McQueen lab, who were all very helpful and friendly.
The research experience overall was great, I felt like I was very much able to incorporate into my lab group. The facilities and setup in general were very much conducive to having a successful summer of research. That said, I wish I could've learned more about what my fellow REU students were doing before the end of the program, maybe some kind of preliminary presentations. Also, I would have appreciated some more built-in social time in the program. As part of a past REU, we took turns cooking dinner for the rest of the cohort in small groups, this was a good way to spend time together in a less academic setting. I know the cooking space is tight staying in dorms on campus, but I think something like this would have improved the social aspect of the REU. All in all, the primary focus of the REU is to enable students to learn a lot and do research, and this REU did a great job of that. The only areas for improvement in my mind are just providing the platform to learn more about what the other students are doing, and more non-academic social outings.
People and the faxt that we are able to dig deeper
The best aspect is the amount of opportunity u can participate in

The mentors and the research subjects were great. Everybody was welcoming and wanted me to learn. The dorms were great to live in. The strawberry festival in Owego was also great. I think the biggest improvement would be an included meal plan. It would have been great to be able to eat there most of the days of the program. As it was it was too expensive to be a feasible consistent meal for me.
I think that it is very important for the REU mentors to have a clear idea of what they want their students to learn over the summer. I was fortunate with my project, but I observed some students who did very little research because their mentors were not interested in teaching them. The students simply plotted data or did other "busy work" for their mentors. I believe that the students who have mentors who teach them about their project and make them part of their research are the most successful in the REU program.
Definitely the hands-on experience if given sufficient training from the mentor or someone else.
I really enjoyed how this program let us work on real and important research projects. This made the projects more interesting and gave me a better idea of what research is like in graduate school. I also think the program was well structured and organized. One potential improvement could be to plan some more opportunities for the REU students to get to know each other. These could be useful at the start of the summer when things are a little slow in lab and everyone is still trying to get to know each other and campus.
I appreciated how many group activities and lectures we had, especially at the beginning of the program. These helped me get to know the other students better, especially those in different labs from me. I also liked that the schedule recommended weekend activities that we could choose to attend; they were very helpful, since I wasn't familiar with the area. In addition, the presentation review at five weeks was very helpful to keep my on track and cognizant of the end goals. The presentation workshop was great, though some of the tips were subjective, and I enjoyed it overall. Having access to the summer school was also helpful, though I might have liked to learn the details earlier so I could let my mentor know more than a couple days in advance that I was planning to attend certain sessions. The Google Drive could've been better organized, but having a shared drive was extremely useful.
The best part was the hands-on experience in the lab and the freedom to explore whatever interested me. The people were also great and I loved getting to know them. Things that could be improved are making sure each participant knows who their mentors are and what their project is. I did not know either until I arrived, but I believe many other participants did.

Summary of Survey Responses

Gains:

- Accessibility to non-science majors
- Patient and understanding throughout experience
- Provided expertise to support experience
    - Knowledgeable in area of study
    - Provided teaching and guidance for many participants
- PI supportive as needed by participants

Considerations for Improvement:

- Some organizational aspects
- More opportunities to use research being taught within projects
- More opportunity to learn about what research other students are doing

When given the opportunity to provide additional comments, 3 of the 17 survey participants provided responses, however one simply responded “no further comments”.

Figure 16. Further Comments

Responses

No further comments, thank you!
Thanks so much for the experience!
This program was one of the best summer experiences I've had, and I'm grateful to have had the opportunity to be here. Not only were the professional development and research engaging, but the people here are amazing, and I never felt like I would be stranded if I needed help. To everyone who dedicated time and effort to making this program what it is, thank you.

Summary of Survey Responses

Gains:

- Positive experience very much appreciated

Considerations for Improvement:

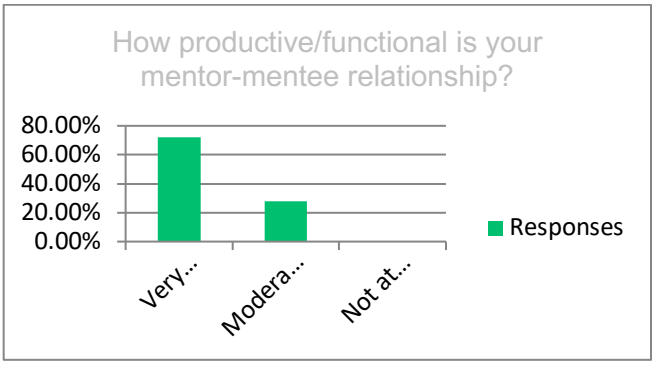
- None mentioned in responses provided

PARADIM Mentee Survey 2023

Productive/Functional Mentor-Mentee Relationship

Participants were asked to indicate the productivity/functionality of the mentor-mentee relationship during REU experience. Of the 18 participants responding to this survey, 18 provided responses to this question and 0 skipped the question. The data indicate that 72% of those responding indicated that they were "Very productive". Additionally, 28% responded "Moderately productive".

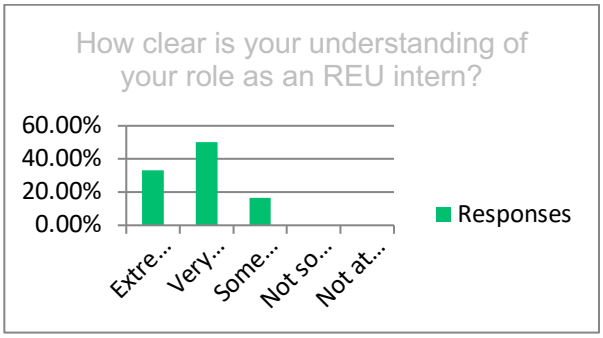
Figure 17. Mentor-Mentee Productivity



Understanding of Role as REU Intern

Participants were asked to indicate their understanding of their role as an REU intern during the REU experience. Of the 18 participants in the survey 18 provided responses to this question and 0 skipped the question. The overall data indicate that 33% of responses indicated that they were "Extremely clear" and 50% responded "Very clear" while 17% responded "Somewhat clear".

Figure 18. Role as REU Intern

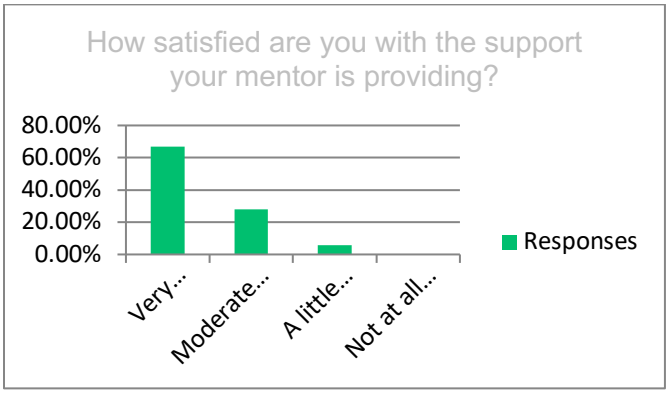


Participant's Satisfaction with Mentor Support

Participants were asked to indicate their satisfaction with the support provided by the mentor throughout the REU experience. Of the 18 participants in the survey 18 provided responses to this

question and 0 skipped the question. The data indicate that 67% of responses indicated that they were “Very satisfied”, 28% responded “Moderately satisfied”, and 5% responded “A little satisfied”.

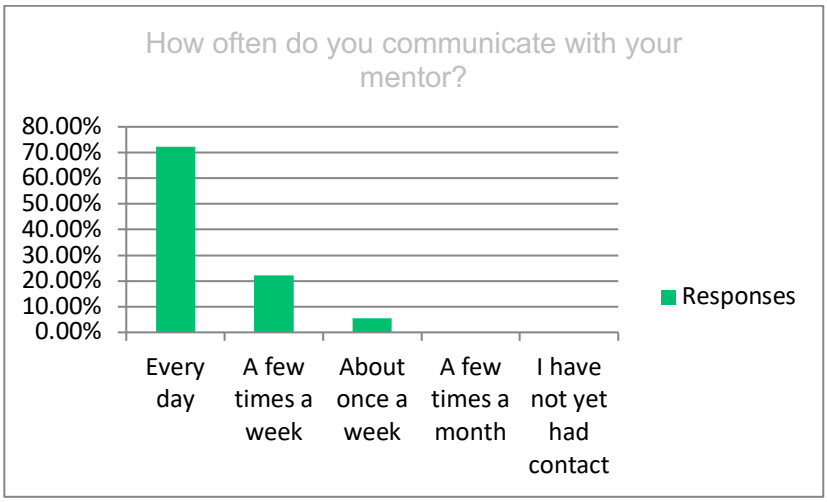
Figure 19. Satisfaction with Mentor Support



Communication with Mentor

Participants were asked to indicate how often they communicated with their mentor. Of the 18 participants in the survey 18 provided responses to this question and 0 skipped the question. The data indicate that 72% of responded “Every day”, 22% responded “A few times a week”, and 6% responded “About once a week”.

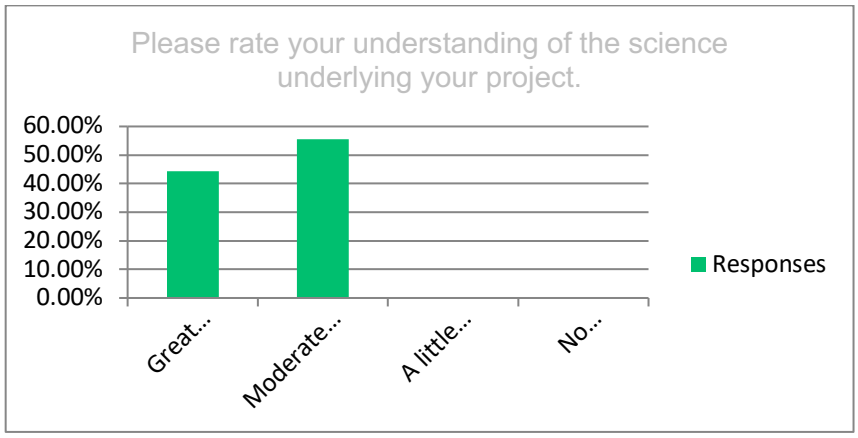
Figure 20. Communication with Mentor



Understanding of Underlying Science

Participants were asked to indicate the understanding of the underlying science regarding the REU experience. Of the 18 participants in the survey 18 provided responses to this question and 0 skipped the question. The data indicate that 44% responded “Great understanding” and 56% responded “Moderate understanding”.

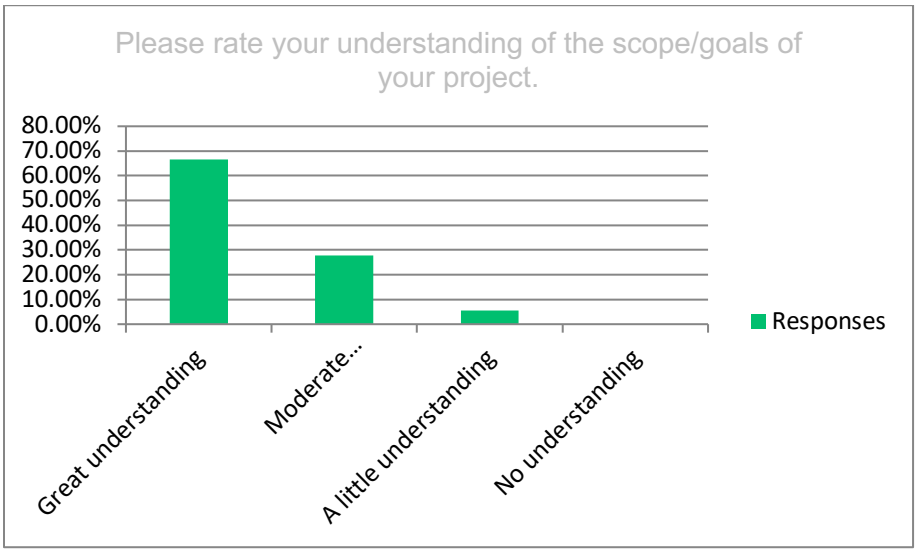
Figure 21. Understanding of Underlying Science



Understanding of Scope/Goals of Project

Participants were asked to indicate the understanding of the scope and goals of the project undertaken during the REU experience. Of the 18 participants in the survey 18 provided responses to this question and 0 skipped the question. The data indicate that 67% responded "Great understanding", 28% responded "Moderate understanding", and 5% responded "A little understanding".

Figure 22. Understanding of Scope/Goals

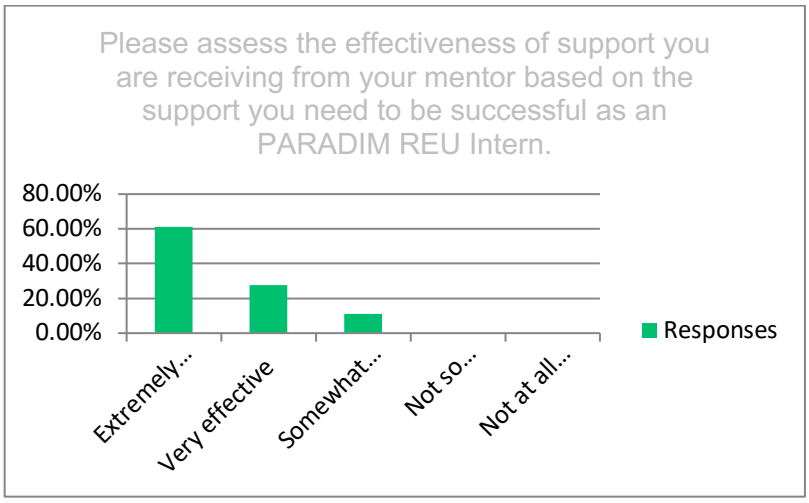


Effectiveness of Mentor Support

Participants were asked to indicate the effectiveness of mentor support in the of the project undertaken during the REU experience. Of the 18 participants in the survey 18 provided responses to this question and 0 skipped the question. The data indicate that 61% responded

"Extremely effective", 28% responded "Nery effective", and 11% responded "Somewhat effective".

Figure 23. Effectiveness of Mentor Support



Additional Comments

Participants were asked to indicate any additional comments on the REU experience. Of the 18 participants in the survey 2 provided responses to this question and 16 skipped the question.

Figure 24. Additional Comments

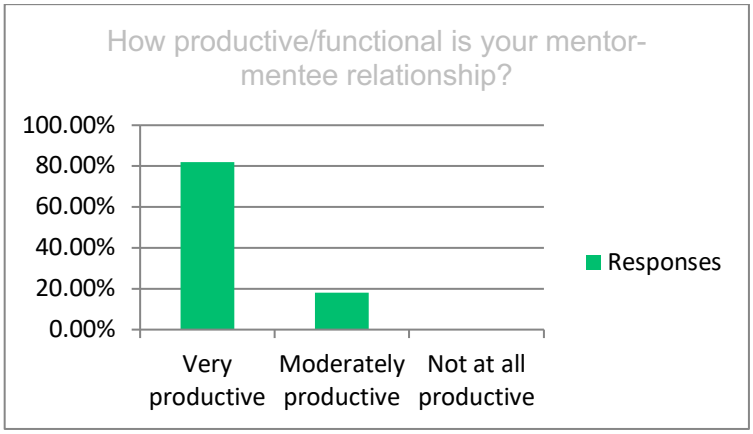
Responses
I would love to give sincere gratitude to everyone in the McQueen lab as they have all be so kind and helpful in my summer journey!
Neha is the coolest and best mentor here and I think she should get more recognition because she's that good!

PARADIM Mentor Survey 2023

Productive/Functional Mentor-Mentee Relationship

Mentors were asked to indicate the productivity/functionality of the REU mentor-mentee relationship during REU experience. Of the 11 mentors in the survey 11 provided responses to this question and 0 skipped the question. The data indicate that 82% of those responding indicated that they were "Very productive" and 18% responded "Moderately productive".

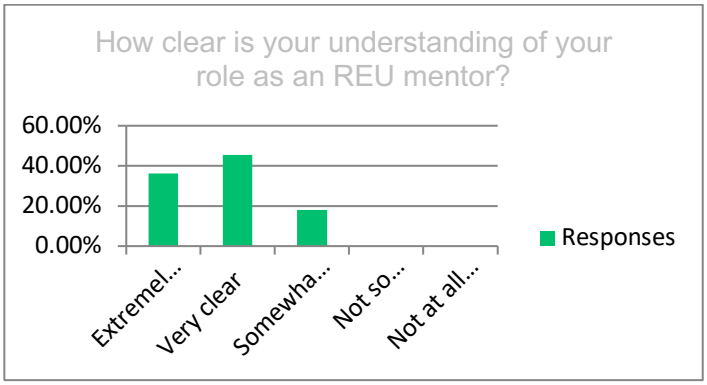
Figure 25. Mentor-Mentee Productivity



Role as REU Mentor

Mentors were asked to indicate understanding of their role as an REU mentor during the REU experience. Of the 11 mentors in the survey 11 provided responses to this question and 0 skipped the question. The data indicate that 36% of responses indicated that they were "Extremely clear" and 46% responded "Very clear" and 18% responded "Somewhat clear".

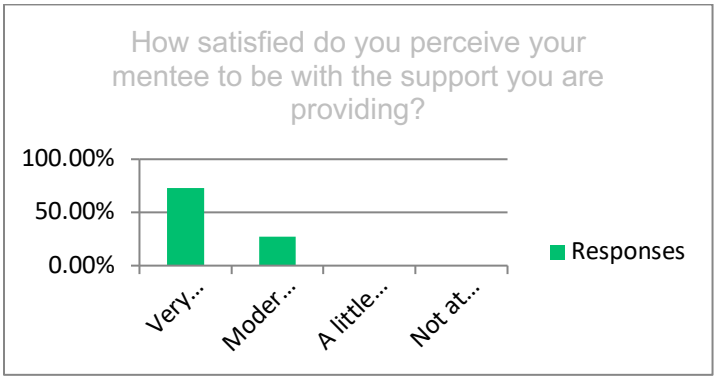
Figure 26. Role as REU Mentor



Mentee Perception of Support Provided

Mentors were asked to indicate the perception of mentees regarding support provided throughout the REU experience. Of the 11 mentors in the survey 11 provided responses to this question and 0 skipped the question. The data indicate that 73% of responded "Very satisfied" and 27% responded "Moderately satisfied".

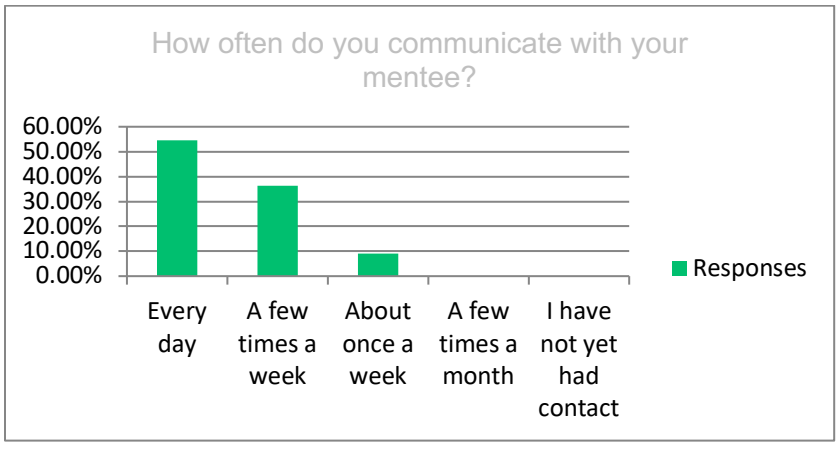
Figure 27. Mentee Perception of Support Provided



Communication with Mentee

Mentors were asked to indicate how often they communicated with their mentee. Of the 11 mentors in the survey 11 provided responses to this question and 0 skipped the question. The data indicate that 55% of responded "Every day", 36% responded "A few times a week", and 9% responded "About once a week".

Figure 28. Communication with Mentee

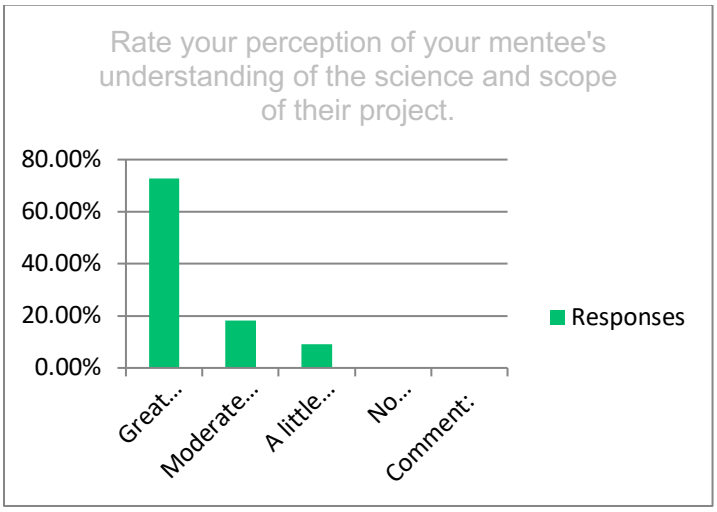


Understanding of Science and Scope of Project

Mentors were asked to indicate perceptions of mentee understanding regarding the science and scope of projects during the REU experience. Of the 11 mentors in the survey 11 provided responses to this question and 0 skipped the question. The data indicate that 73% responded

"Great understanding", 18% responded "Moderate understanding" and 9% responded "A little understanding".

Figure 29. Understanding of Science and Scope of Project



Mentor Assessment of Support

Mentors were asked to indicate impressions of support provided during the REU experience. Of the 11 mentors in the survey 11 provided responses to this question and 0 skipped the question. The data indicate that 27% responded "Extremely effective", 55% responded "Very effective" and 18% responded "Somewhat effective".

Figure 30. Mentor Assessment of Support

Additional Comments

Mentors were asked to indicate any additional comments on the REU experience. Of the 11 mentors in the survey 1 provided a response and 10 did not provide additional comments.

Figure 31. Additional Comments

Responses
The REU is very eager to learn the future prospects of the project they are working on and explore the literature independently. The REU comes with very good questions and queries and we discuss them.

FINAL PRESENTATIONS

The PARADIM Evaluation Team conducted virtual observational assessments of REU students presentations.. The assessment metrics related to each presentation included:

- Organization,
- Visuals,
- Delivery,
- Content,
- Illustrations/Examples/Metaphors

A 1-5 Likert-type scale was employed: Poor/Inadequate; Below Average; Average; Above Average; Excellent/Professional Quality. In addition, the evaluator-observer team took brief notes on the content and their perceptions of the presentations.

Following is a summary of the evaluator data:

PARADIM Presentation Evaluations

1. **Mr. Henry Bowman**

Cornell REU
Carleton College
Mentor: Cameron Gorsak

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
4.5	5.0	3.5	4.5	2.5

Notes:

Organization – Became more clear as presentation continued.
Visuals – All visuals connected to content and supported presentation.
Delivery – Conveyed content knowledge. However, demonstrated a struggle speaking to groups and relied on reading from screen.
Content – Demonstrated content well as well as providing next steps. Used personal images at end to create a connection beyond the research – made it very accessible.
Examples/Metaphors/Illustrations – Few connections made beyond the research.

2. **Ms. Ishani Cheshire**

Cornell REU
University of California at Berkley Mentor:
Harikrishnan Kunhikrishnan Premakumari

Organization	Visuals	Delivery	Content	Examples/Metaphors/Illustration
5.0	5.0	5.0	5.0	2.0

Notes:

Organization – Jumped directly into content but a clear path through content became apparent quickly.
Visuals – All visuals connected to content and supported presentation and used gesturing to direct audience to specific visuals.
Delivery – Eye contact with audience created a connection and demonstrated an understanding and comfort with presenting.
Content – Demonstrated content through detailed explanations and ensured success by directing audience through content
Examples/Metaphors/Illustrations – Few examples but very engaged with audience that it supported a deeper understanding.

3. Mr. Yufan Feng
Cornell REU
Cornell University
Mentor: Qi Song

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	5.0	5.0	2.0

Notes:

Organization – Extremely well organized with use of slides and transitions to indicate the steps taken in the project.
Visuals – More visuals than text on screen which were used well and explained.
Delivery – Mostly looking at audience which was driven using visuals over text on screen. Turned to look at screen in order to highlight aspects important to the presentation.
Content – Explained how equipment worked which provided a base of understanding for the research – great choice as it set the audience up to remain engaged and connected to presentation.
Examples/Metaphors/Illustrations – Very limited examples/metaphors/illustrations beyond the content of the presentation.

4. Mr. Casey Kim
Cornell REU
Cornell University
Mentor: Jinkwon Kim

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
4.0	4.0	4.0	4.5	2.0

Notes:

Organization – Not clear at the start but very well organized as presentation continued.
Visuals – All visuals connected to content and explained all throughout presentation.
Delivery – Nerves apparent at start but dissipated quickly and the confidence with content drove that change.
Content – Shared things still to be examined which demonstrated how research leads to new paths and a confidence in the research.
Examples/Metaphors/Illustrations – Few that allowed for any connection beyond the audience present.

5. **Mr. Tomas Kraay**

Cornell REU
Cornell University
Mentor: Anna Park

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	5.0	5.0	2.0

Notes:

Organization – Motivation and goals of research outlined and drove presentation.
Visuals – Clear and well used well.
Delivery – Confident with research which provided confidence in presenting research.
Content – Provided aspects still to be examined based on the data from the summer.
Examples/Metaphors/Illustrations – Few that would allow for a connection with wider audience.

6. **Ms. Adriana Lavopa**

Cornell REU

University of Florida
Mentor: Evan Li

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
n/a	n/a	n/a	n/a	n/a

Notes: Pending publication by mentor

7. Ms. Kira Martin

Cornell REU
University of Illinois at
Urbana-Champaign
Mentor: Jacob Steele

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	5.0	5.0	3.0

Notes:

Organization – Very clear organization from the beginning of presentation.
Visuals – Well presented and drew audience attention to portions as needed. Formulas included and explained.
Delivery – Looking back and forth from screen to audience but not reading screen, using the shifts to highlight and explain what was on screen.
Content – Connected to previous research in order to put current research in context.
Examples/Metaphors/Illustrations – Where and when examples connected to research are being used beyond research.

8. Mr. Ian Mercer

Cornell REU
North Carolina
State University
Mentor: Neha Wadehra

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	4.5	5.0	2.0

Notes:

Organization – Clear as soon as began presentation.
Visuals – Connected but some were busy on the screen. However, those that were busy with content were well used and described offsetting the amount of information on the screen.
Delivery – Mainly looking at screen and left side from audience perspective.
Content – Discussed research as well as other that impacted project – well used.
Examples/Metaphors/Illustrations – Lacked throughout but did show some images to support this area.

9. Ms. Pheandria (PJ) Miller

Cornell REU
Texas A&M University
Mentor: Jinkwon Kim

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	5.0	5.0	2.0

Notes:

Organization – Laid out what was examined immediately, and the pathway presentation would follow. Well organized and went back in presentation to add value to current section of presentation.
Visuals – Clear and well used by drawing attention to portions being discussed.
Delivery – Looked between audience and screen and referred back to previous slides, going back as needed to enhance presentation.
Content – Very extensive and clear. Provided context as needed.
Examples/Metaphors/Illustrations – Lacked throughout with only a brief mention.

10. Mr. Luke Omodt

Cornell REU
Augsburg University
Mentor: James Hwang

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	4.5	4.0	4.0	2.0

Notes:

Organization – Clearly organized.
Visuals – More text than charts and graphs (or other visuals) but used well.
Delivery – Out from behind computer and made eye contact with entire audience as well as using eyes to highlight screen.
Content – Offered the HOW things worked and why the goals of the project were set the way they were.
Examples/Metaphors/Illustrations – Attempts made but did not extend much past direct content.

11. Mr. Nicholas Redwing

Cornell REU

Penn State University
Mentor: Nicholas Parker

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
4.5	5.0	5.0	5.0	2.0

Notes:

Organization – Clear organization.
Visuals – Very clear and connected to the project and used visuals to enhance presentation. Very little text on screen which enhanced presentation.
Delivery – Mainly looked at screen but not reading from screen just supporting descriptions of project.
Content – Straight forward and descriptive – good explanations of the process and project.
Examples/Metaphors/Illustrations – Provided few examples, metaphors and/or illustrations.

12. Ms. Hayley Ruddich
Cornell REU
Arizona State
University
Mentor: Tobias Schwaigert

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	4.0	4.0	5.0	2.0

Notes:

Organization – Clearly organized and provided the "why" of the project to support organization.
Visuals – Well connected but wordy in the beginning. However visuals were used to set up understanding.
Delivery – Standing behind computer with eyes on audience but eyes on the computer or screen.
Content – Began with the "why" and kept content true to that start to enhance understanding.
Examples/Metaphors/Illustrations – Few outside examples, metaphors and/or illustrations.

13. Ms. Yongwen Zheng
Cornell REU
University of California Los Angeles
Mentor: Qi Song

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	4.5	5.0	2.0

Notes:

Organization – Clear order beginning with the "why" and then the procedure.
Visuals – Relevant and highlighted as needed to enhance meaning.
Delivery – Standing out and away from computer with eyes alternating between audience and screen. When looking at screen it was to support highlighting of content.
Content – Gave the WHY and continued to refer back to it throughout the presentation – very supportive to overall content explanation.
Examples/Metaphors/Illustrations – Few examples, metaphors, and/or illustrations beyond project.

14. Mr. Jayson Johnson
JHU REU
Howard University
Mentor: Thomas Whoriskey

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	5.0	5.0	5.0

Notes:

Organization – Clearly organized from beginning and maintained the organization throughout.
Visuals – Connected well using charts, graphs and explanations.
Delivery – Excitement about project which supported explanations and drew the audience into the presentation. Very confident.
Content – Clear understanding and ability to convey the content stemming from personal excitement for the project.
Examples/Metaphors/Illustrations – Used a number of connections with a connection to cooking providing an accessibility to the content.

15. Mr. Aviana Judd
JHU REU
University of Kentucky
Mentor: Satya Kushwaha

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	5.0	5.0	5.0

Notes:

Organization – Laid out the order of the presentation verbally starting with beginning of project and then maintained a very clear order throughout.
Visuals – Very clearly connected to content and were used to drive the entire presentation.
Delivery – Began with her lack of knowledge of topic which drew the audience in and then the excitement about learning supported delivery of information.
Content – Confidence and use of visuals made content accessible.
Examples/Metaphors/Illustrations – Used Periodic Table, MRI machine and other connections to strengthen presentation.

16. Mr. Gannon Murray
JHU REU
Earlham College
Mentor: David Elbert
and Brandon Wilfong

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	5.0	5.0	5.0	3.0

Notes:

Organization – Clear and organized from the start. Included background to support organization.
Visuals – All visuals well connected and highlighted as necessary to improve audience understanding.
Delivery – Demonstrated confidence and excitement that drew audience into the presentation. Voice inflections added another positive dimension to the delivery.
Content – Defined as needed through a deep understanding of the project.
Examples/Metaphors/Illustrations – Few provided throughout the presentation.

17. Mr. Nathan Song
JHU REU
University of California at
Berkley
Mentor: Tyrel McQueen

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
5.0	4.5	5.0	5.0	2.5

Notes:

Organization – Clear organization beginning with the "why" behind the project.
Visuals – Clear and explained throughout. Highlighted as needed.
Delivery – Confidence and excitement demonstrated. Clear language used to enhance content.

Content – Definitions provided as needed to support content knowledge.
Examples/Metaphors/Illustrations – Few provided throughout the presentation.

18.Ms. Selena Coye

Clark-Atlanta University - Summer Research Explorers Program (SREP)
Clark-Atlanta University
Mentor: Katie Azizie

Organization	Visuals	Delivery	Content	Examples/ Metaphors/Illustration
n/a	n/a	n/a	n/a	n/a

Notes: Pending publication by mentor

Student Presentations: Conclusions/Considerations

As both the numerical metrics and the observation narratives demonstrate, there was a high degree of quality in the presentations by the 16 presenters (2 students did not present as projects being considered for publication). In nearly all the five variables studied by the evaluation team, students across the board scored at and above 4.0 (above average), with many receiving top grades of 5.0 (excellent/professional quality). The evaluator was highly impressed that these undergraduate college students could combine the technical content with the ability to communicate so well and clearly. In the metrics for Illustrations/Examples/Metaphors – there was an observable lack of these connections being made in most presentations and those that did use a few connections in this metric could have made the connections more accessible to those outside the field of study (Note: A few participants attempted this with confidence that added much to the clarity of the work.). The evaluator suggests that to ensure that students - in college and in career - are able to communicate well to both science- and non-science- publics, helping audiences "see" the unfamiliar in familiar ways is a strength. There were some signs of this in some of the presentations, and it is recommended that continued direct instruction in this variable be considered for future REU iterations. Improve use of space and eye contact with more audience members to improve engagement by those in audience. And overall, there seemed to be a general improvement over last year in many of the skill areas.

Appendix

Complete Survey Details (2023 REU Survey)

Question 1

Please indicate your REU:		
Answer Choices	Responses	
PARADIM @ Cornell University	82.35%	14
PARADIM @ Johns Hopkins University	17.65%	3
	Answered	**17**
	Skipped	**0**

Question 2

Please rate the following lecture, training session, and activities, as well as your overall REU experience:											
Rating											
	Poor		Fair		Good		Excellent		Did Not Attend		Total
June 8th: Berit Goodge, Brendan Faeth, Nick Ng, Drake Niedzielski, The Four Corners of PARADIM	0.00%	0	17.65%	3	35.29%	6	41.18%	7	5.88%	1	17
June 9th: Jill Powell, Library Science	0.00%	0	29.41%	5	47.06%	8	11.76%	2	11.76%	2	17
June 12th: Orientation Safety Training (Zoom)	0.00%	0	47.06%	8	23.53%	4	0.00%	0	29.41%	5	17
June 15th: Workshop on Research Ethics and Responsible Conduct	0.00%	0	17.65%	3	47.06%	8	29.41%	5	5.88%	1	17
June 20th or 27th: Prof. Julie Nucci, Jim Overhiser, Science communications and Presentation skills workshop	5.88%	1	17.65%	3	35.29%	6	41.18%	7	0.00%	0	17
June 22nd: Chirality Magic from Magic Sized Clusters	5.88%	1	35.29%	6	35.29%	6	11.76%	2	11.76%	2	17
June 26th: Lynn Vincent, Collaboration Workshop	0.00%	0	23.53%	4	23.53%	4	17.65%	3	35.29%	6	17
June 29th: Steve Zeltmann, Hot Materials Talk	0.00%	0	11.76%	2	41.18%	7	47.06%	8	0.00%	0	17
July 13th: CNF Clean Room Tour	0.00%	0	5.88%	1	35.29%	6	35.29%	6	23.53%	4	17
July 27th: Hot Materials Talk	0.00%	0	5.88%	1	35.29%	6	17.65%	3	41.18%	7	17
Aug. 7th: CU Synchrotron Tour (Wilson Lab)	0.00%	0	0.00%	0	11.76%	2	64.71%	11	23.53%	4	17
The two slide/presentation preview sessions with Jim Overhiser	0.00%	0	11.76%	2	23.53%	4	64.71%	11	0.00%	0	17
									Answered		**17**
									Skipped		**0**

Question 3

How much did you gain in the following areas as a result of this REU research experience?									
Academic Gain									
	Little or No Gain		Moderate Gain		Great Gain		Not Applicable		Total
Familiarity with a range of research techniques	5.88%	1	23.53%	4	70.59%	12	0.00%	0	17
Mastery of project-specific research techniques	5.88%	1	17.65%	3	76.47%	13	0.00%	0	17

Presentation skills	0.00%	0	52.94%	9	47.06%	8	0.00%	0	17
Explaining my project to people outside my field	5.88%	1	29.41%	5	64.71%	11	0.00%	0	17
Writing scientific reports or papers	29.41%	5	35.29%	6	35.29%	6	0.00%	0	17
Understanding journal articles	5.88%	1	76.47%	13	17.65%	3	0.00%	0	17
Conducting library database searches	29.41%	5	47.06%	8	17.65%	3	5.88%	1	17
Making a research poster	23.53%	4	35.29%	6	41.18%	7	0.00%	0	17
Making a research poster	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0
							Answered		**17**
							Skipped		**0**

Question 4

How much did you GAIN in the following areas as a result of this REU research experience?									
Academic Gain									
	Little or No Gain		Moderate Gain		Great Gain		Not Applicable		Total
Preparation for advanced course/thesis work	11.76%	2	35.29%	6	52.94%	9	0.00%	0	17
Preparation for graduate school	5.88%	1	23.53%	4	70.59%	12	0.00%	0	17
Preparation for an academic or industrial career	5.88%	1	23.53%	4	70.59%	12	0.00%	0	17
Interest in materials science research	5.88%	1	29.41%	5	64.71%	11	0.00%	0	17
Interest in some other scientific research/career	29.41%	5	35.29%	6	29.41%	5	5.88%	1	17
Confidence in my ability to contribute to science	5.88%	1	29.41%	5	64.71%	11	0.00%	0	17
							Answered		**17**
							Skipped		**0**

Question 5

Please provide further explanation of your responses, particularly any "little or no gain" responses. Also, did you make any other gains that we didn't mention?	
Answered	**9**
Skipped	**8**
Responses	
All gain areas that I were not already strong in made "Great Gain", while areas that I believed I was already strong in had improvements, but not large ones, hence "Moderate Gain"	
I didn't think that I gained much skill in understanding journal articles.	
Would really like in the future if one of the hot talks was about writing our reports, we went over the poster and presentation but never the report	
This experience was a strong affirmation of my aspirations to pursue a career in materials research.	
I would say I made significant gains in every area in which I spent significant time. Pretty much across the board, the more time I put into something, the more gain I got out	
I learned a lot about just about everything. This experience really grew my confidence for future grad school possibilities.	
This mostly pertains to my mentor and the poor quality of mentorship I found as the summer progressed. I had high hopes for Cornell and was severely disappointed when I was assigned the busywork of the project. I was not present for a majority of the MBE growth - largely due to arriving and having a handful of samples that needed to be measured. This was not what was frustrating - the lack of communication of WHY we needed those datasets in addition to HOW he wanted them precisely measured was commonly missed. Early in the summer I was encouraged to ask questions and unfortunately the first round of explanations were insufficient and the papers were long and very dense, so upon asking again I found my “mentor” telling me he had already explained such things to me. This was frustrating to me and ended up really taking away from the project - I was now unmotivated, inexperienced and quite demoralized very early on into the summer. Unfortunately this did not improve as we began working on the project halfway through the summer - he would not provide me updates on growth	

parameters, experimental logic when changes were made, or on any work/data he took when I was not present in the lab. Fortunately this was not my first laboratory experience but I think had I not been familiar with research beforehand I would have left PARADIM and Cornell very disappointed and unlikely to pursue research later on.
We learned about how to use the library databases during a presentation, but I did not use a database at any point this summer.
I gained a lot in all areas mentioned, and I also developed greatly in navigating both the successes and failures in the research process.

Question 6

As a result of this REU research experience, how likely you are to:

How likely?

	Not more likely. This is still not my plan.		Not more likely. This was already my plan.		More likely		Not applicable		Total
...switch to a new/different major in college?	70.59%	12	17.65%	3	5.88%	1	5.88%	1	17
...pursue a new/different minor in college?	70.59%	12	17.65%	3	5.88%	1	5.88%	1	17
...pursue a career in science or engineering? (industry and/or academic)	5.88%	1	82.35%	14	11.76%	2	0.00%	0	17
...pursue a career in materials science, specifically? (industry and/or academic)	23.53%	4	35.29%	6	41.18%	7	0.00%	0	17
...present a talk or poster at a conference?	17.65%	3	11.76%	2	70.59%	12	0.00%	0	17
...write or co-write a paper to be published in an academic journal?	11.76%	2	17.65%	3	64.71%	11	5.88%	1	17
...write or co-write a paper to be published in an undergraduate research journal?	23.53%	4	0.00%	0	52.94%	9	23.53%	4	17
							Answered		**17**
							Skipped		**0**

Question 7

If you indicated that you are likely to present, publish, or apply for an award/scholarship based on your research this summer, please tell us more:	
Answered	**17**
Skipped	**0**
Responses	Tags
i prepared a poster and would love to present it.	
My contribution to the research my mentor and I did during the summer is most likely to be used in a future paper, which I will most likely credit when applying to future awards/scholarships	
This program raised my confidence and gave me new opportunities	
N/a	
I gain greater academic abilities hence I have greater potential to do so	
Dependent on results this fall, some publications may be possible	
I will be a co author on one of the graduate students paper	
I had never considered it to be a possibility before this experience, but now I feel like I have more confidence and experience to pursue publication.	
I am working with my grad student mentor, PI, and a few other coauthors to write up a paper summarizing my summer project. Some further work may be required to finish this paper, but it will largely be based on my work this summer.	
N/A	
N/a	

I was lucky enough to have the ability to work on two projects that expect to publish relatively soon. I also felt my contributions were more than simply doing what I was told to do; I contributed ideas and direction as well.
I was able to conduct my own original research, which I will hopefully be able to present and/or publish.
n/a
Each fall some undergraduate students at my university go to the Material Science & Technology conference, if there are open spots I may present my work from the summer at the undergraduate poster or speaking event.
I would like to present my summer research at my university's Fall undergraduate research symposium. I am also considering applying to present at a regional poster session for undergraduate researchers.
na

Question 8

As a result of this REU research experience, how likely you are to:									
How likely?									
	Not more likely. This is still not my plan.		Not more likely. This was already my plan.		More likely		Not applicable		Total
...apply to a Master's program in science, math, or engineering?	58.82%	10	23.53 %	4	11.76%	2	5.88%	1	17
...apply to a Ph.D. program in science, math, or engineering?	0.00%	0	70.59 %	12	29.41%	5	0.00%	0	17
...apply to nursing, medical, dental, pharmaceutical, or veterinary school?	88.24%	15	5.88%	1	0.00%	0	5.88%	1	17
...apply to a professional program not already mentioned? (e.g., law, library science, business, social work, journalism, etc.)	94.12%	16	0.00%	0	0.00%	0	5.88%	1	17
...apply to a graduate program in a non-STEM field? (e.g., social science, humanities, fine arts, etc.)	100.00%	17	0.00%	0	0.00%	0	0.00%	0	17
...apply for an award or scholarship based on your research?	23.53%	4	5.88%	1	70.59%	12	0.00%	0	17
								Answered	**17**
								Skipped	**0**

Question 9

In your own words, how did your REU experience influence your thinking about future career and graduate school plans (or not)? Please explain.	
Answered	**17**
Skipped	**0**
Responses	
I would like to pursue a PhD degree in the pursue in the field of MSE.	
My REU experience did not change much about whether or not I went to graduate school, as I had already decided that I wanted to beforehand. However, it made me think more about the specific fields I'd like to work in, what I'd like to do, and what being a graduate student actually involves.	
It opened me up to the possibility of material science as a career path for me.	
I feel even more confident that this area of research is what I want to continue doing.	
Give me a sense of real research	
This experience introduced me to great mentors, an amazing project, and exposed me to new people and grew my skills as a researcher and communicator. Working with people in the direct area of research I am interested in gave me confidence in applying to and contributing to graduate schools in the near future, and confirmed my interest in a higher education.	
It helped me get an understanding of what I would be doing in grad school	

My REU experience has affirmed my interest in a materials-related research career. However, I am still not sure if I want to pursue an experimental or computational specialty.
My REU experience only strengthened my confidence in my original plan to pursue a PhD in materials science or a closely related field. Although I was already planning on this course of action, my REU gave me reassurance that this is what I want to do
It solidified my liking for materials science and would like to continue studying
Made me consider material science as a career
It grew my confidence in my ability to succeed in a career in research. It also taught me new things that gave me new passions.
I really enjoyed my research experience this summer. I had already planned to pursue a PhD, but this experience gave me more of an idea of what it will be like.
Fortunately this was not my first laboratory experience so I will still apply for PhD programs elsewhere but I think had I not been familiar with research beforehand I would have left PARADIM and Cornell very disappointed and unlikely to pursue research later on.
I was already planning to apply to PhD programs in Material Science and Engineering. This REU experience helped me feel more confident in that decision and explore a new research topic I may pursue in grad school.
This REU gave me more confidence in my plans to pursue a graduate degree in materials science and engineering. I may not remain in the field of thin film growth, but I have come to enjoy materials characterization, and I could see myself pursuing a graduate degree in nanomaterials.
The REU has made me aware of the importance of carefully choosing whose lab you work in and how the people there can help or hinder you.

Question 10

Please indicate the degree of support you received from your PI/Grad mentor in the preparation of your final presentation:		
Answer Choices	Responses	
No support	0.00%	0
Little support	5.88%	1
Some support	29.41%	5
A great deal of support	64.71%	11
	Answered	**17**
	Skipped	**0**

Question 11

From your perspective, how important is the mentor to the success of the REU experience?		
Answer Choices	Responses	
Not at all important	0.00%	0
Slightly important	0.00%	0
Moderately important	11.76%	2
Extremely important	88.24%	15
	Answered	**17**
	Skipped	**0**

Question 12

From your perspective, to what degree did your mentor influence your future plans?		
Answer Choices	Responses	
Not at all	5.88%	1
Slightly	23.53%	4
Moderately	17.65%	3
A great deal	52.94%	9
	Answered	**17**
	Skipped	**0**

Question 13

Please elaborate on your mentor experience:	
Answered	**17**
Skipped	**0**
Responses	
She guided me through the project by providing fruitful feedbacks and taught me important scientific concepts	
In my opinion, my mentor, Nick Parker, was an extremely great mentor. We did a lot of great work together with my project, and he was always letting me get hands-on experience, whether it was with the characterization equipment or the MBE. He also always took the time to explain concepts in detail to me when I was confused. When I was preparing for my presentation, he spent multiple hours helping me plan out the talk and making comments and feedback to my slides that I thought really helped the final result. In the end, we did as much work as I thought we could possibly do in the timeframe that we had, and the only negative I had was that I could not stay longer to finish what we weren't able to get to.	
My mentor was very present and we met almost every day of the summer. I learned a lot from him because of it.	
Neha is a great teacher and a great person and both of those things impacted our work a lot.	
My mentor can help me a lot but not always available.	
Great support, great mentorship, and great communication. It was very helpful to have a mentor who took the initiative sometimes to arrange meetings, as I have a tendency to get stuck on a problem and stubbornly hack at it. Access to a mentor who was open to undergraduate research and supportive of new students was invaluable.	
My mentor was good about explaining things to me and helped me make my presentation	
My mentor took a supportive but hands-off approach that allowed for flexibility and personal discovery without feeling overwhelmed or confused. I had clear goals, but determining how to pursue them was left for me to explore. I believe that I learned much more this way then I would have with a more prescriptive approach, or with less guidance.	
I couldn't find enough superlatives to describe my mentor! Cameron was fantastic. He provided guidance when I needed it, but also let me work on my project independently when I was capable. He was extremely nice and dependable throughout the entire process, I have nothing but positive things to say about him.	
He was great	
I had a good experience, and learned a lot from my mentor	
I had multiple mentors this summer, and they all were wonderful. They were very receptive on any questions I had. They were very welcoming, so I felt as if I was part of the lab. I can't say enough things about how great they were. They also gave valuable information on how to choose a grad school.	
I collaborated well, and was able to get advice from not only my mentor, but from many other members of the lab group.	
Calling him a “mentor” is overly generous - it was more of a business transaction with very little guidance from him. I detailed this in a previous question.	
I think my mentor did a good job training me on equipment and teaching me about the background of the project at the start of the summer. He was helpful whenever I had questions or needed help. It was also helpful to hear his perspective as he did this REU as an undergrad.	
My mentor, Evan, was fantastic, I could not have asked for a better experience. His patience and willingness to explain every question, no matter how simple, greatly helped me, especially since I entered the program with little prior knowledge about electronic materials or oxides. His explanations were always excellent, his guidance helped me grow immensely, and I appreciated that he wanted to make this summer an enjoyable experience.	

My mentor was always willing to help me in the lab or explain some concept; however, I felt that he was not the best at explaining these concepts or the purpose of my project in a way that I could understand. I was often frustrated by ending up more confused after I asked him for help. I also had a grad student mentor who was wonderful. She helped me with many of the machines I used and was there for anything else I needed. The only downside was that the projects she worked on were very different from mine, meaning she couldn't always explain some of the background concepts I was trying to understand.

Question 14

How likely are you to recommend this REU program to your peers?		
Answer Choices	Responses	
Very likely	58.82%	10
Likely	29.41%	5
Unlikely	5.88%	1
Very Unlikely	5.88%	1
Please elaborate:	0.00%	0
	Answered	**17**
	Skipped	**0**

Question 15

What were the best aspects of the REU program? What aspects are most need of improvement? Please take time to reflect and elaborate	
Answered	**17**
Skipped	**0**
Responses	Tags
I love the aspect of working with a PhD or postdoc and actually contribute to their work	
I enjoyed the hands-off approach, especially since I had already done multiple REU programs and did not need too much support through multiple scheduled events/tutorial presentations. The equipment that I was able to work with was very impressive and made me better understand the Materials Science field of research.	
I liked that the program was reasonably accessible even to non material science majors. I think that one of the aspects of the REU program most in need of improvement is that our cohort never really coalesced into a supportive group of peers. We mostly kept to ourselves. I think that if the program organizers organized more PARADIM REU-specific social events early on, or had us present our projects to each other to practice earlier in the summer, then this would not have happened. Furthermore, I think that in general the program could hold its' students to a higher standard. In previous REU experiences, professors have held my work to a similar standard as their graduate students. This summer, however, I noticed that professors expected far less of us.	
I love it all.	
The research I'm conducting is very cool. However, the program is disorganized and information given is inconsistent. For instance, the program coordinator told us that all healthcare expenses at Cornell Health will be paid for. This fact was confirmed with several interns. But later the coordinator claimed it's only the insurance that the program is paying for and refuted he said otherwise.	
The best aspects were the great mentor and overall focus on research. Compared to another REU I attended last year, the lack of nonessential / mandatory activities helped save time for research, and it really made the most of the 10 weeks that we had. I can't think of any improvements, except maybe some better communication rules for mentor mentor relationships. My mentor was amazing, but from what I heard from my labmates a very small amount of mentors were unclear on their expectations and goals.	
I liked how all Rey's were able to get together for hot talks and our meetings with Jim about our presentation. To improve I would say the first week there need to be more activities for us reu to get to know each other such as when the jhu people came we had pizza at the dorms.	
The best aspects of the REU program were the opportunities to work on relevant, meaningful work with the support of the entire McQueen lab, who were all very helpful and friendly.	
The research experience overall was great, I felt like I was very much able to incorporate into my lab group. The facilities and setup in general were very much conducive to having a successful summer of research. That said, I wish I could've learned more about what my fellow REU students were doing before the end of the program, maybe some kind of preliminary presentations. Also, I would have appreciated some more built-in social time in the program. As part of a past REU, we took turns cooking dinner for the rest of the cohort in small groups, this was a good way to spend time together in a less academic setting. I know the cooking space is tight staying in dorms on campus, but I think something like this would have improved the social aspect of the REU.	

All in all, the primary focus of the REU is to enable students to learn a lot and do research, and this REU did a great job of that. The only areas for improvement in my mind are just providing the platform to learn more about what the other students are doing, and more non-academic social outings.
People and the faxt that we are able to dig deeper
The best aspect is the amount of opportunity u can participate in
The mentors and the research subjects were great. Everybody was welcoming and wanted me to learn. The dorms were great to live in. The strawberry festival in Owego was also great. I think the biggest improvement would be an included meal plan. It would have been great to be able to eat there most of the days of the program. As it was it was too expensive to be a feasible consistent meal for me.
I think that it is very important for the REU mentors to have a clear idea of what they want their students to learn over the summer. I was fortunate with my project, but I observed some students who did very little research because their mentors were not interested in teaching them. The students simply plotted data or did other "busy work" for their mentors. I believe that the students who have mentors who teach them about their project and make them part of their research are the most successful in the REU program.
Definitely the hands on experience if given sufficient training from the mentor or someone else.
I really enjoyed how this program let us work on real and important research projects. This made the projects more interesting and gave me a better idea of what research is like in graduate school. I also think the program was well structured and organized. One potential improvement could be to plan some more opportunities for the REU students to get to know each other. These could be useful at the start of the summer when things are a little slow in lab and everyone is still trying to get to know each other and campus.
I appreciated how many group activities and lectures we had, especially at the beginning of the program. These helped me get to know the other students better, especially those in different labs from me. I also liked that the schedule recommended weekend activities that we could choose to attend; they were very helpful, since I wasn't familiar with the area. In addition, the presentation review at five weeks was very helpful to keep my on track and cognizant of the end goals. The presentation workshop was great, though some of the tips were subjective, and I enjoyed it overall. Having access to the summer school was also helpful, though I might have liked to learn the details earlier so I could let my mentor know more than a couple days in advance that I was planning to attend certain sessions. The Google Drive could've been better organized, but having a shared drive was extremely useful.
The best part was the hands-on experience in the lab and the freedom to explore whatever interested me. The people were also great and I loved getting to know them. Things that could be improved are making sure each participant knows who their mentors is and what their project is. I did not know either until I arrived, but I believe many other participants did.

Question 16

Please use the space below for any further comments you would like to add:	
Answered	**3**
Skipped	**14**
Responses	
No further comments, thank you!	
Thanks so much for the experience!	
This program was one of the best summer experiences I've had, and I'm grateful to have had the opportunity to be here. Not only were the professional development and research engaging, but the people here are amazing, and I never felt like I would be stranded if I needed help. To everyone who dedicated time and effort to making this program what it is, thank you.	

PARADIM Mentee Survey 2023 (Complete Survey Results)

Question 1

How productive/functional is your mentor-mentee relationship?		
Answer Choices	Responses	
Very productive	72.22%	13
Moderately productive	27.78%	5
Not at all productive	0.00%	0
Comment:		4
	Answered	**18**
	Skipped	**0**

Question 2

How productive/functional is your mentor-mentee relationship?		
Answer Choices	Responses	
Very productive	72.22%	13
Moderately productive	27.78%	5
Not at all productive	0.00%	0
Comment:		4
	Answered	**18**
	Skipped	**0**

Question 3

How satisfied are you with the support your mentor is providing?		
Answer Choices	Responses	
Very satisfied	66.67%	12
Moderately satisfied	27.78%	5
A little satisfied	5.56%	1
Not at all satisfied	0.00%	0
Comment:		3
	Answered	**18**
	Skipped	**0**

Question 4

How often do you communicate with your mentor?		
Answer Choices	Responses	
Every day	72.22%	13
A few times a week	22.22%	4

About once a week	5.56%	1
A few times a month	0.00%	0
I have not yet had contact	0.00%	0
Comment:		2
	Answered	**18**
	Skipped	**0**

Question 5

Please rate your understanding of the science underlying your project.		
Answer Choices	Responses	
Great understanding	44.44%	8
Moderate understanding	55.56%	10
A little understanding	0.00%	0
No understanding	0.00%	0
Comment:		3
	Answered	**18**
	Skipped	**0**

Question 6

Please rate your understanding of the scope/goals of your project.		
Answer Choices	Responses	
Great understanding	66.67%	12
Moderate understanding	27.78%	5
A little understanding	5.56%	1
No understanding	0.00%	0
Comment:		0
	Answered	**18**
	Skipped	**0**

Question 7

Please assess the effectiveness of support you are receiving from your mentor based on the support you need to be successful as an PARADIM REU Intern.		
Answer Choices	Responses	
Extremely effective	61.11%	11
Very effective	27.78%	5
Somewhat effective	11.11%	2
Not so effective	0.00%	0
Not at all effective	0.00%	0
Comment:		2
	Answered	**18**
	Skipped	**0**

Comment:
The feedback is helpful but can take half of a day to receive before I can move to the next step.
Neha puts in so much effort to make sure I understand things by answering all my questions to the best of her ability, and mostly without judgement.

Question 8

If you have anything you would like to add or discuss further, please use the space below.Thank you.	
Answered	**2**
Skipped	**16**
Responses	
I would love to give sincere gratitude to everyone in the McQueen lab as they have all be so kind and helpful in my summer journey!	
Neha is the coolest and best mentor here and I think she should get more recognition because she's that good!	

PARADIM Mentor Survey 2023 (Complete Survey Results)

Question 1

How productive/functional is your mentor-mentee relationship?		
Answer Choices	Responses	
Very productive	81.82%	9
Moderately productive	18.18%	2
Not at all productive	0.00%	0
Comment:		1
	Answered	**11**
	Skipped	**0**

Comment:
The REU understands the task well and explore more than one potential avenues to perform a task

Question 2

How clear is your understanding of your role as an REU mentor?		
Answer Choices	Responses	
Extremely clear	36.36%	4
Very clear	45.45%	5
Somewhat clear	18.18%	2
Not so clear	0.00%	0
Not at all clear	0.00%	0
Comment:		0
	Answered	**11**
	Skipped	**0**

Question 3

How satisfied do you perceive your mentee to be with the support you are providing?		
Answer Choices	Responses	
Very satisfied	72.73%	8
Moderately satisfied	27.27%	3
A little satisfied	0.00%	0
Not at all satisfied	0.00%	0
Comment:		0
	Answered	**11**
	Skipped	**0**

Question 4

How often do you communicate with your mentee?		
Answer Choices	Responses	
Every day	54.55%	6
A few times a week	36.36%	4
About once a week	9.09%	1
A few times a month	0.00%	0
I have not yet had contact	0.00%	0
Comment:		0
	Answered	**11**
	Skipped	**0**

Question 5

Rate your perception of your mentee's understanding of the science and scope of their project.		
Answer Choices	Responses	
Great understanding	72.73%	8
Moderate understanding	18.18%	2
A little understanding	9.09%	1
No understanding	0.00%	0
Comment:	0.00%	0
	Answered	**11**
	Skipped	**0**

Question 6

Based on your impression of the support your intern needs, please assess your effectiveness as their mentor.		
Answer Choices	Responses	
Extremely effective	27.27%	3
Very effective	54.55%	6
Somewhat effective	18.18%	2
Not so effective	0.00%	0
Not at all effective	0.00%	0
	Answered	**11**
	Skipped	**0**

Question 7

If you have anything you would like to add or discuss further, please use the space below.Thank you.	
Answered	**1**
Skipped	**10**
Responses	Tags
The REU is very eager to learn the future prospects of the project they are working on and explore the literature independently. The REU comes with very good questions and queries and we discuss them.	