PARADIM Research Experiences for Undergrads (REU)

Fall 2025

Mary Downes Consulting LLC

Contents

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. These projects include improving the techniques available within PARADIM to grow and characterize materials. Students selected will work on an independent research project using the advanced resources available in PARADIM facility labs and the facilities of the Cornell Center for Materials Research (CCMR).

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.

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

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

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. Presentation Observations – Evaluator observations of intern presentations, employing a multi-criteria assessment instrument
3. Intern Survey – A post-program survey seeking intern information related to program quality (lectures, mentoring, research, presentation, virtual delivery)

After all data were compiled and analyzed, an 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.

Findings: Student Presentations

The 2025 PARADIM REU program culminated in a series of final presentations delivered by undergraduate researchers from a diverse set of institutions across the country. Each student presented the results of a 10-week research project conducted under the mentorship of Cornell University or Johns Hopkins faculty and graduate/postdoctoral researchers.

The goals of these presentations were to:

- Demonstrate mastery of a specific research project.
- Communicate complex scientific findings to a broad technical audience.
- Practice professional skills in oral presentation, scientific visualization, and audience engagement.

The evaluation rubric was applied consistently across the cohort, with equal weight assigned to five categories: *Organization, Visuals, Delivery, Content*, and *Examples/Metaphors/Illustrations*. Scores ranged from 1 (needs improvement) to 5 (excellent), with averages calculated to provide an overall assessment for each student.

Observations

Average presentation scores ranged from **3.4 to 4.2** across the cohort (out of 5). The highest-scoring presentation reflected both professional-level polish and strong audience engagement. The lowest scores reflected challenges with delivery clarity and accessibility, though all demonstrated valuable progress in research communication.

Rohini Ghosh

Rohini Ghosh is from Tucson, Arizona. She is a rising senior at the University of Arizona studying Chemical Engineering with a minor in Statistics and Data Science. At the University of Arizona, she does research with Dr. Suchol Savagatrup in engineering soft materials for applications in environmental sensing. In her free time, Rohini enjoys reading, crocheting, playing the flute, and watching soccer.

PI: Darrell Schlom
Cornell Mentor: Steven Zeltmann/Noah Schnitzer/Hongbin Yang
Project: Optimizing an event-driven detector for high-speed scanning diffraction measurements in the transmission electron microscope

Final Presentation: Overall Average Score:3.8

Category	Notes	Score
Organization	Clear path through content and precise set-up of expectations	4
Visuals	Visuals included diagrams of diffraction patterns, energy deposition maps, and plots comparing detector parameters. These were appropriate and supported the explanation. Could be elevated with slightly more simplified/annotated figures for non-specialists.	4
Delivery	Fast paced. Delivery was clear but leaned heavily into technical detail. Some filler words (“like,” “so”) and long sentences suggest a less polished oral delivery. Still understandable, but pacing and simplification for the audience could be improved.	3
Content	Strong command of the technical subject. The explanation of detector physics, Monte Carlo simulations, and trade-offs between thickness, threshold, DQE, and MTF was thorough and accurate. High-level content quality.	5
Examples/ Metaphor/ Illustration	While strong data-driven examples were given, the presentation lacked analogies or metaphors to make complex physics more accessible to broader audiences.	3

Monique Kubovsky

Monique Kubovsky is a rising senior from Mechanicsburg, Pennsylvania. She studies physics and mathematics at the University of Florida. At UF, she works under Dr. Amlan Biswas, exploring ferromagnetic domain movement in manganite thin films. She plans to earn a Ph.D. in physics and pursue an academic research career aimed at exploring the physics underlying peculiar magnetic effects. She is passionate about mentorship within physics, hoping to support underrepresented students through her involvement with the Society of Physics Students. At Cornell, she looks forward to further developing her experimental skills, while also diving deep into the physics of materials. Apart from coursework and research, she enjoys hiking, ice skating, birdwatching, reading, and cooking.

PI: Darrell Schlom
Cornell Mentor: Yorick Birkholzer / Maya Ramesh
Project: Thermal annealing of novel substrates for the growth of oxides with the rutile crystal structure

Final Presentation: Overall Average Score: 3.8

Category	Notes	Score
Organization	The presentation was logically organized: introduction → motivation (superconductivity in rutile thin films) → criteria for substrate selection → preparation methods → results by substrate → summary.	4
Visuals	They were highly technical but appeared well-aligned with the talk's focus. A few additional schematics could have helped non-specialists follow the step height/double termination discussion more easily.	4
Delivery	Delivery showed confidence and mastery of technical detail, but leaned heavily on long, information-dense sentences. Technical jargon was not always unpacked for a broader audience.	3
Content	Very strong: excellent depth, well-supported results, and clear conclusions. Deep understanding of substrate prep.	5
Examples/ Metaphor/ Illustration	Limited. Few attempts to use metaphors.	3

Johannes Loock

Johannes Loock is from Austin, Texas and was born in Praetoria, South Africa. He attends Hillsdale College, where he studies Physics and Applied Mathematics with the goal of one day acquiring a PhD in Astrophysics or Cosmology. Under the guidance of Dr Timothy Dolch and Dr Nathan Herring, he has researched the 2024 eclipse's effects on the ionosphere and the behavior of scaler quantum fields in a radiation dominated cosmology. In his free time, he plays Dungeons and dragons, listens to audiobooks, and dabbles in hard sci-fi worldbuilding.

PI: Darrell Schlom
Cornell Mentor: Luka Mitrovic/Evan Krysko
Project: Angle-Resolved Photoemission Spectroscopy and Transport Studies on Cubic Perovskite $BaRuO_3$ Thin Films Grown by Molecular-Beam Epitaxy

Final Presentation: Overall Average Score 4.0

Category	Notes	Score
Organization	The presentation followed a clear arc (motivation → material challenge → approach → results → future work).	4
Visuals	Visuals (XRD, RSM, resistivity curves, RHEED scans) were central to the story, but explanations often assumed a specialist audience.	3
Delivery	Delivery was engaging, personable, and conversational, which made complex physics approachable. Humor and enthusiasm helped.	4
Content	Excellent scientific depth. Jean clearly demonstrated understanding of physics and the challenges of stabilizing cubic phases. Strong integration of background, results, and limitations.	5
Examples/ Metaphor/ Illustration	Stronger than the previous talks in this category. Phrases like "that's not a kink, that's a bump of unknown origin" helped humanize the data, though more analogies could have elevated accessibility further.	4

Brenan Palazzolo

Brenan Palazzolo is a rising junior from Easley, South Carolina. She attends Clemson University where she is pursuing her degree in Physics with a Materials Science and Engineering minor. At Clemson University, Brenan is working under Dr. Chad Sosolik to study the mechanical changes of a double paddle oscillator when impacted by ions. In the future, she hopes to pursue a PhD in condensed matter physics. Outside of courses and research, Brenan enjoys reading, trying new foods, and cats.

PI: Darrell Schlom
Cornell Mentor: Tobias Schwaigert
Project: Electronic properties of novel perovskite derivatives

Final Presentation: Overall Average Score 3.4

Category	Notes	Score
Organization	The talk had a strong logical structure: background on perovskites → introduction of ETO and its ordering → growth challenges → experimental optimization → results and future directions	4
Visuals	Visuals (crystal structures, band diagrams, charge density maps, XRD scans) were clearly central to the explanation. They were technical but useful. Explanations of what to "look for" (e.g., ordering peaks, fringes) were clear.	3
Delivery	Delivery was confident and thorough, with strong command of details. Brenan answered audience questions directly and clearly, showing mastery of the work. The presentation was less conversational than most but more polished and structured, though at times it moved quickly through jargon-heavy sections.	3
Content	Excellent depth. The presentation explained both the physics and the materials growth challenges (oxidation states, shutter times, substrate matching). It showed a strong integration of theory, experiment, and future implications.	5
Examples/ Metaphor/ Illustration	The presentation was heavily technical. While structural schematics and band diagrams were effective, there were very few analogies or metaphors to make the material more approachable for non-specialists.	2

Isaac Perez

Isaac Perez is from Modesto, California. He is a rising senior at Harvey Mudd College, where he studies math-physics, and philosophy. At HMC, he works with Professor Ethan Ritz to discover materials with strong flexoelectric properties using computational methods for the future use of harvesting green energy. He also seeks to make science more accessible to incarcerated students through the Prison Education Project. In his free time, he likes to read, play the guitarrón, and skateboard!

PI: Darrell Schlom
Cornell Mentor: Dylan Sotir
Project: High-temperature growth of pseudosubstrate-quality perovskite oxide thin films

Final Presentation: Overall Average Score 4.2

Category	Notes	Score
Organization	Isaac followed a strong logical sequence: background on superlattices → phonons and lattice vibrations → methods (DFT, Green's function) → preliminary results → future work.	4
Visuals	Visuals (superlattice structures, phonon dispersion curves, schematic 1D chain, sample "fake" transmission spectrum) effectively supported explanations. Strength: he used simplified analogies like springs and 1D chains to help the audience interpret complicated plots.	4
Delivery	Delivery was clear, confident, and enthusiastic. He balanced technical depth with accessibility by breaking down concepts (springs, dispersion relations) into more digestible pieces. He maintained good engagement.	4
Content	Very strong technical depth. Content showed a strong grasp of both physics and computation.	5
Examples/ Metaphor/ Illustration	Better than most peers in this category. Isaac used analogies (springs, mass-spring systems, wave comparisons) and even humor ("suspicious person squishing my crystal"). These touches made complex material more approachable. More everyday metaphors could further improve accessibility, but his effort here stood out.	4

Yingxiao Liao (Thea)

Thea was born in Beijing, China. She is currently a rising senior at Caltech, majoring in Materials Science. Under the guidance of Dr. Xuemei Cheng, she conducted research involving the fabrication of gold disks by sputtering for precision radiotherapy studies. Her goal is to pursue a PhD in Materials Science, aspiring to deepen her understanding of advanced materials characterization and contribute to cutting-edge research in nanomaterials. She hopes to improve her experimental techniques and learn from distinguished faculty and fellow researchers. In her free time, she enjoys dancing and playing basketball.

PI: Tyrel McQueen
JHU Mentor: Satya Kushwaha
Project: Development of single crystals of quantum materials using floating zone furnaces at PARADIM
Final Presentation: Overall Average Score 3.8

Category	Notes	Score
Organization	Thea's talk was well structured: introduction to quantum computing → skyrmions and motivation → synthesis method → floating zone growth → characterization → next steps. Clear progression.	4
Visuals	Strong use of visuals: crystal structures, floating-zone furnace video, diffraction images, and XRD plots. These supported the narrative well.	4
Delivery	Delivery was careful and methodical, but pacing was sometimes slow and phrasing occasionally hesitant. Some reliance on reading rather than extemporaneous explanation reduced polish. Still clear enough to follow and demonstrated solid preparation.	3
Content	Excellent technical depth. Thea demonstrated understanding of quantum computing concepts, skyrmions as qubits, and the details of crystal growth/characterization. Linking her synthesis results to potential quantum applications was a strong aspect.	5
Examples/ Metaphor/ Illustration	The talk was highly technical with few analogies or metaphors. Concepts like "skyrmions as nano-bubbles" appeared only briefly at the end (in Q&A) and were helpful—more of this throughout would make the material more accessible.	3

Parker Green

Parker Green is from Guthrie, Oklahoma. She is a rising senior at The University of Tulsa studying Mechanical Engineering and Mathematics. Parker has conducted research with Dr. William LePage in the Advanced Materials Design Group at TU for two years, where she has researched surface treatment techniques to increase fatigue resistance in shape memory alloys and aerospace metals. In her free time, she enjoys reading and singing. She also has two Green thumbs (pun intended) and loves taking care of plants!

PI: Tyrel McQueen
JHU Mentor: Allana Iwanicki
Project: Are AI/ML Methods Any Good For Accelerating Materials Discovery?

Final Presentation: Overall Average Score 4.2

Category	Notes	Score
Organization	Parker's talk had a clear arc: introduction to superconductors → AI/ML closed-loop design concept → synthesis and characterization → discovery of unknown phase → single-crystal work → future steps. The narrative was strong, though the middle sections were dense.	4
Visuals	Visuals (levitating magnet, XRD patterns, structure comparisons, crystal images) supported the story well. Showing both experimental data and schematic analogies was effective.	4
Delivery	Delivery was confident and engaging. Parker conveyed enthusiasm for the research, especially when describing unexpected findings (crystal growth, unknown phases). Delivery was polished and clear.	4
Content	Excellent scientific depth. Parker balanced a thorough introduction to superconductivity with detailed experimental methods and results.	5
Examples/ Metaphor/ Illustration	The use of levitation visuals and clear "closed-loop" AI diagrams helped ground the technical content. While most examples were still technical, Parker provided more intuitive illustrations than some peers, which helped the audience connect.	4

Carina Jacobson

Carina Jacobson is from Bloomington, Indiana and attends Purdue University. She is a rising junior majoring in physics and mathematics. She works with Prof. Alexandru Georgescu in his computational research group at Indiana University. She studies the effects of He-doping on symmetry breaking and metal-insulator transitions in correlated electron materials. In her free time, Carina enjoys backpacking, crafting, and reading.

PI: Tyrel McQueen
JHU Mentor: Gregory Bassen
Project: Are AI/ML Methods Any Good For Accelerating Materials Discovery?

Final Presentation: Overall Average Score 4.0

Category	Notes	Score
Organization	Carina's talk was structured clearly: intro to superconductors → motivation for AI/ML → closed-loop workflow → synthesis and characterization → example material → results and next steps. Smooth transitions and logical sequencing made it easy to follow.	**4**
Visuals	Strong use of visuals: structural diagrams of cuprates, schematic of closed-loop ML, PXRD data with highlighted peaks. The annotation of "unknown" peaks was effective. Some figures were technical but well explained.	**4**
Delivery	Delivery was clear, confident, and steady. Carina spoke at a good pace and used accessible language to connect AI/ML concepts to synthesis. Slightly less animated than some peers, but professional and easy to follow.	**4**
Content	Excellent depth. She explained superconductors, AI/ML's role, and experimental workflows with precision. Her discussion of isolating unknown phases showed understanding of both computational motivation and lab work.	**5**
Examples/ Metaphor/ Illustration	While her explanations were clear, the talk leaned technical. She didn't use many analogies or metaphors beyond the standard levitation example at the start. Adding more intuitive comparisons could have boosted accessibility.	**3**

Steven May

Steven May is from Tampa, Florida and is a rising Senior at Georgia Tech. He is a chemistry major with a concentration in materials and polymers, and he conducts research on additively manufactured polymeric materials in Dr. Meisha Shofner's materials science and engineering laboratory. After graduating, Steven plans on pursuing a PhD in materials science. Outside of classes, Steven is a member of the Georgia Tech Drumline and enjoys playing and watching hockey.

PI: Tyrel McQueen
JHU Mentor: Thomas Whoriskey
Project: Are AI/ML Methods Any Good For Accelerating Materials Discovery?

Final Presentation: Overall Average Score 3.8

Category	Notes	Score
Organization	The talk had a clear flow: superconductors → AI/ML framework → synthesis strategies (solid state, flux) → results → limitations → future work.	4
Visuals	Strong use of visuals: XRD spectra, phase diagrams, sealed tube images, and flux results. They effectively supported the narrative. A couple of slides were data-heavy and could have benefited from cleaner highlighting, but they conveyed the technical results well.	4
Delivery	Delivery was clear but less polished than some peers. Steven occasionally filled with “uh” and “does that make sense?” which made it feel more conversational than professional.	3
Content	Excellent depth. He showed strong command of synthesis techniques (solid-state, tube sealing, flux), their limitations, and how they relate to AI-predicted materials	5
Examples/ Metaphor/ Illustration	He provided some analogies (e.g., “floor and ceiling” metaphor for project outcomes, framing results as part of a spectrum rather than success/failure). These were effective, but limited. More intuitive illustrations could have made the flux/oxidation discussion more accessible.	3

Christopher Williams

Christopher Williams is from Aurora, Colorado, moved to Austin, Texas in 2018, and enrolled into Prairie View A&M University in 2020, currently pursuing a degree(s) in Physics and Mathematics. Chris performed research in Density Functional Theory where he made optoelectronic calculations on a perovskite (CsPbBr3) to learn the basics of understanding the theory behind DFT and learning Vienna Ab initio Simulation Package (VASP) which is a software that is used to host pseudopotentials and more to perform calculations on given materials. Chris wants to pursue this PhD in theoretical biophysics, as he desires to understand the electric and potentially magnetic properties of biological systems and build on the mathematical models used to understand bioelectric systems, one being Neuroscience/Neurology. Aside from a massive passion for the math & sciences, Chris enjoys video games, roller-skating/skateboarding, tinkering, philosophical discussions, educational videos, and becoming more sustainable.

PI: Tyrel McQueen
JHU Mentor: Abby Neill
Project: Are AI/ML Methods Any Good For Accelerating Materials Discovery?

Final Presentation: Overall Average Score 3.4

Category	Notes	Score
Organization	The presentation followed a logical outline—intro to superconductivity → project workflow → what DFT is → how it's applied → examples → summary. However, transitions were sometimes meandering, with repeated "I'll explain more later" that interrupted the flow.	3
Visuals	He referenced equations, convex hull diagrams, and example reactions. These were useful, but the explanations often outpaced the visuals (audience had to hold details in memory).	3
Delivery	Engaging and personable, injecting humor and authenticity. However, delivery was informal at times, with filler words and long tangents that made sections less crisp.	3
Content	Good depth—he explained DFT fundamentals, formation energy, convex hull stability, and reagent dependence. His discussion of how calculations guide experimentalists showed solid grasp of the science.	4
Examples/ Metaphor/ Illustration	Used analogies well: "multi-body problem gets confusing real quick," "convex hull shows why compounds are stable," "they didn't want to die from fluoride" → memorable. His explanation of DFT using electron densities and pseudo-potentials was accessible, though occasionally too detailed for a general audience.	4

Rihana Burciaga

Rihana Burciagaa 3rd year Chemical Engineering student at Clark Atlanta University and soon Georgia Institute of Technology. She is currently on track to become a Cosmetic Chemist with my main goal of using her creativity to lead the way for new breakthroughs in the Cosmetic Industry. Some of her creative passions include singing, reading, sewing/repurposing clothes, creating skincare essentials at home, crocheting, yoga, and much more!

PI: Darrell Schlom
Cornell Mentor: Jacob Steele
Project: Refining α-Al_2O_3 Substrate Preparation for Conductive α-$(Al_xGa_{1-x})_2O_3$ Thin Films

Final Presentation: Overall Average Score 3.8

Category	Notes	Score
Organization	Strong, logical structure: introduction of the problem → why α-Ga_2O_3 matters → substrate challenges → annealing strategies → results → future work. Clear transitions between "problem → method → results."	4
Visuals	Visuals supported her points well, though at times the figures were crowded (many images shown quickly). Good use of comparative visuals (e.g., "under-annealed" vs. "over-annealed")	4
Delivery	Confident and clear — spoke in complete sentences, used technical vocabulary appropriately. Engaging, though occasionally fast-paced (some technical explanations moved quickly). Very professional tone overall, though less polished than the very best (e.g., Parker).	4
Content	Very strong technical depth. Accurate and well-supported, showing mastery of both background and experimental details.	5
Examples/ Metaphor/ Illustration	Relied mostly on technical AFM images and parameter comparisons. Less use of metaphors or analogies to help general audiences; very much a specialist presentation.	3

Amari Gayle

Amari Gayle is a sophomore at Clark Atlanta University majoring in Dual Degree Engineering with a concentration in biology. I am currently conducting research with PREM, studying how potassium chloride (KCl) functions as a seeding promoter for tungsten disulfide (WS_2) growth on sapphire substrates. After graduation, I hope to pursue a career in biomedical engineering, potentially designing prosthetics for children, though still exploring his options. In his free time, Amari enjoys listening to music, watching movies, and spending time with my family.

PI: Darrell Schlom
Cornell Mentor: Olivia Peek
Project: Growth and Characterization of Silver Oxide Thin Films
Final Presentation: Overall Average Score 3.4

Category	Notes	Score
Organization	Presentation had a logical arc (background → methods → results → conclusions), but flow was uneven and transitions were sometimes unclear	3
Visuals	Strong use of AFM, XRD, scans, and schematic diagrams. Figures supported points well, though explanation of what each showed could have been clearer for accessibility.	4
Delivery	Delivery was understandable but somewhat read-like and uneven. Technical terms sometimes mumbled or unclear, making it harder to follow	3
Content	Solid technical depth: discussed polymorphs, twinning, growth conditions, and results with specificity. Clear scientific contribution.	4
Examples/ Metaphor/ Illustration	Used figures effectively, but few simplified analogies/metaphors for accessibility. Audience questions suggested they wanted more intuitive explanation.	3

Tyi Jones

Tyi is from West Palm Beach, Florida, and is a rising junior at Spelman College dual majoring in physics and mechanical engineering. At Spelman College, Tyi conducts research on the characterization of thin films using Mossbauer spectroscopy, working in the PREM program under the supervision of Dr. Natarajan Ravi. She hopes to pursue a master's degree in mechanical engineering. In her free time, Tyi enjoys reading, listening to music, and binging TV series.

PI: Darrell Schlom
Cornell Mentor: Anna Park
Project: Molecular-beam epitaxy of $SrMoO_3$ and Sr_2MoO_4 films by adsorption control
Final Presentation: Overall Average Score 3.8

Category	Notes	Score
Organization	Presentation had a solid logical flow (intro → material properties → growth method → results → conclusion). Transitions were mostly smooth, though some answers to questions could have been tighter.	4
Visuals	Strong use of comparative graphs (resistivity, figure of merit), XRD scans, and optical data. Some slides were dense and could have benefited from clearer labels.	4
Delivery	Clear, confident, and professional tone. Engaged audience with interactive question ("which is the film?"). A few minor filler phrases, but overall polished.	4
Content	Well-grounded in scientific detail (transparent conducting oxides, MBE growth challenges, figure of merit). Could have expanded broader implications a bit more, but depth was strong.	4
Examples/ Metaphor/ Illustration	Technical explanations were strong, but relied mostly on data figures rather than analogies. The "guess the transparent film" moment was a good illustrative touch.	3

Observation Summary

Overall, the cohort demonstrated strong technical mastery and commendable effort in distilling complex research into concise presentations. The average scores across all categories ranged from 3.4 to 4.2, showing both areas of strength and opportunities for growth.

- Content was the strongest category, reflecting deep engagement with experimental methods, data analysis, and broader scientific context.
- Organization was generally strong, though some transitions could be smoother.
- Visuals were effective overall, but some slides were dense and could benefit from clearer annotation.
- Delivery varied: some students were polished and engaging, others relied heavily on technical jargon or slides.
- Examples/Metaphors was the lowest scoring area, indicating room to grow in making technical work accessible to broader audiences.

In summary, the 2025 REU cohort excelled in mastering challenging research projects and demonstrated solid progress in communicating results. With further emphasis on delivery skills and the use of analogies to connect with non-specialists, future cohorts can continue to raise the standard of clarity and impact in scientific presentations.

Findings: Student Survey

The 2025 PARADIM Research Experience for Undergraduates (REU) program, hosted jointly by Cornell University and Johns Hopkins University, provided undergraduate researchers with an immersive ten-week research and professional development experience. To capture participant feedback and assess program quality, a comprehensive post-program survey was administered to all student researchers. The survey gathered input on multiple aspects of the REU experience, including research mentoring, laboratory and technical training, seminars and workshops, cohort community, and overall satisfaction. Responses were collected across both host sites to highlight strengths, identify areas for improvement, and inform planning for future REU cohorts.

This report synthesizes findings from the survey, presenting both quantitative ratings and qualitative reflections. The results provide valuable insight into how students experienced the research environment, academic support, and professional development opportunities, and they will serve as an important tool for continuous program enhancement.

Student Perceptions

Directly after the conclusion of the 2025 REU program, the Evaluation Team administered a post-survey to all (13) interns. The intent was to collect data from participants focused on what worked, what could have been better, and how the experience influenced future endeavors

Program Events/Activities

REU participants were asked to rate (11) events, from workshops on presentation skills and collaboration to “Hot Topic Talks” related to Materials Discovery. The scale ranged from “poor” to “excellent” with “fair” and “good” included on the scale. Approval Rating indicates the % of attending respondents who rated the speaker “good” or “excellent” none of the REU participants rated any of the activities as “poor” the remainder were those who marked the experience as “fair.”

Presentations	Approval Rating
The Four Corners of PARADIM: Berit Goodge, Davor Tolj, Brendan Faeth, Drake Niedzielski	91%
Library Science, Deborah Bauder	91%
Workshop on Research Ethics and Responsible Conduct	90%
Science Communications and Presentation Skills Workshop, Prof. Julie Nucci, Jim Overhiser	100%
Hot Materials Talk - Guided Materials Discovery (Virtual Lab Tour) Tyrel McQueen	92%
Hot Materials Talk - Highest Resolution Image Steve Zeltmann	92%
CNF Clean Room Tour	75%
Hot Materials Talk - Bio-Inspired Composites, Lara Estroff	100%
Presentation Review Sessions with Jim Overhiser	100%
Ethics Presentation - David Muller	85%
CU Synchrotron Tour (Wilson Lab)	100%

Program Gains - Research Techniques

Through survey questions students were given the opportunity to reflect on the impact of the REU experience on their academic skills, interests and planning, preparation for the future, and their confidence level. As indicated below, the REU interns reported moderate to high gains in several areas including familiarity and mastery of a range of research skills and presentation skills.

REU participants were asked to reflect on their perceived academic gain in the following (8) areas.

Academic Skill/Area of Expertise	Achieved Moderate/Great Gain
Familiarity with a range of research techniques	100%
Mastery of project-specific research techniques	100%
Presentation skills	100%
Explaining my project to people outside my field	100%
Writing scientific reports or papers	85%
Understanding journal articles	92%
Conducting library database searches	62%
Making a research poster	85%

This year's REU included an emphasis on Presentation Skills, including multiple large group sessions and one-on-one tutoring. With a focus on the ability to communicate complex scientific research in layman's terms, the presenter offered several techniques including analogies and visuals to communicate research principals.

While 'Conducting library database searches' saw the least gains reported by students, the comments added some context for this:
"While we had a brief talk on library databases, I felt that much of what was covered I already knew. For the other boxes where I selected "little or no gain," I felt like I was already extremely interested in materials science research/other scientific research, so it was hard to "gain" more interest.
Many comments were positive, "I say the program was great for my development as a scientific researcher. I really enjoyed the training received on giving presentations and having access to graduate students that were able to teach me the Physics and Chemistry concepts needed to perform my project."

Program Gains - Preparedness

Gains were also reported in areas related to preparedness. REU participants were asked the degree to which the REU experience prepared them for future work in a variety of fields as well as how the experience influenced areas of interest:

Academic Skill/Area of Expertise	Achieved Moderate/Great Gain
Preparation for advanced course/thesis work	100%
Preparation for graduate school	100%
Preparation for an academic or industrial career	92%
Interest in materials science research	85%
Confidence in my ability to contribute to science	100%

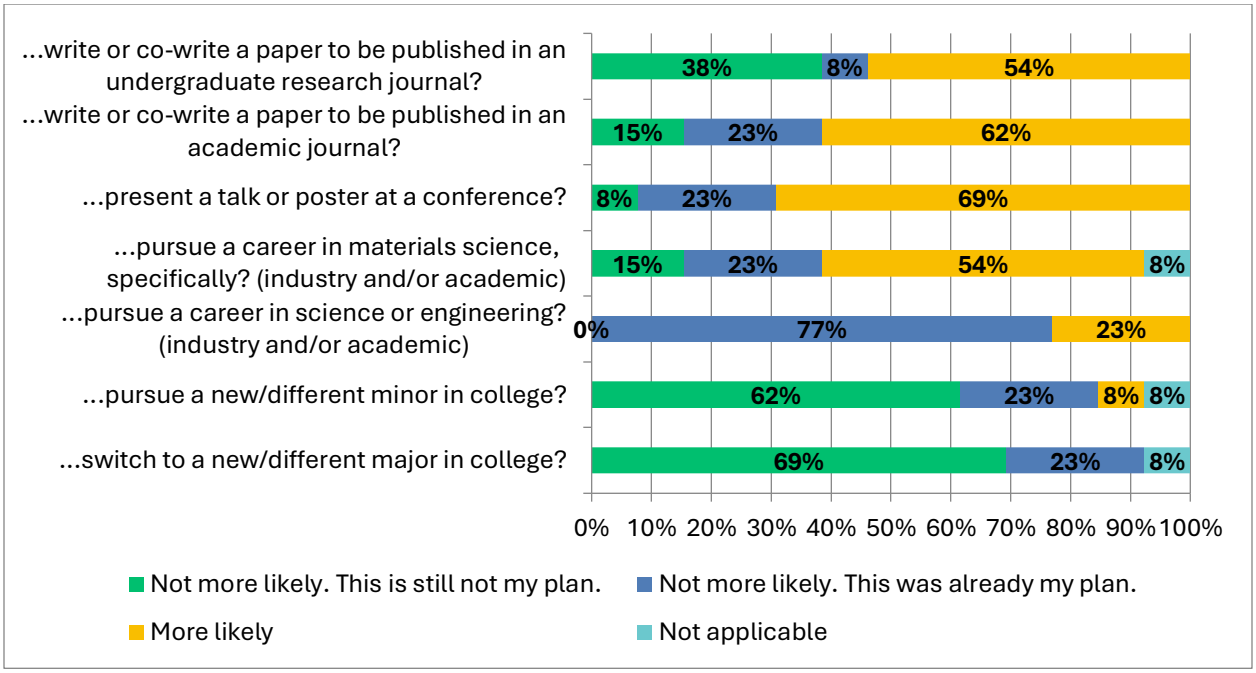
All of the participants reported gains in their preparedness for advanced course work, graduate school, and confidence in their ability to contribute to science and the vast majority felt gains in their preparedness for continued material science research or potentially an industrial career.

REU Experience as Influence

To provide clarity, a follow-up question asked If the REU interns were likely to present, publish, or apply for an award/scholarship based on their summer research. Several

interns stated that because of the REU experience they felt they were in a more favorable position to secure a scholarship. Others added they plan to present their work when they return to their school in the fall. Interns were also motivated by the opportunity to contribute to research likely to be published in the future and dedicated to continuing to refine the work.

Figure 1. As a result of this REU research experience, how likely you are to:



Participants reported a range of anticipated next steps and opportunities related to their summer research experience:

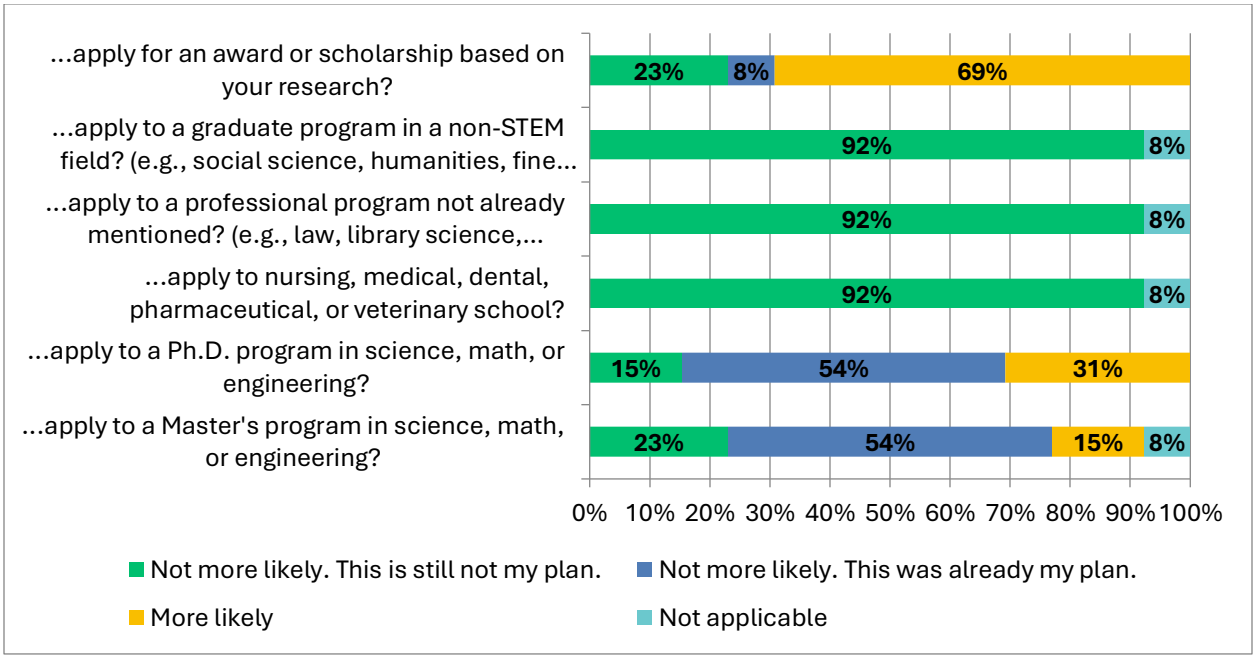
- Presentations and Posters: Several students noted plans to present their work at poster sessions at their home institutions, at national or regional conferences (e.g., AVS, Gulf Coast Undergraduate Research Symposium, Northwestern REU Symposium), or in other academic forums.
- Publications and Scholarly Output: A few students expressed intentions or possibilities of co-authoring papers with their mentors, though others were uncertain about whether their projects would yield publishable results.
- Scholarships and Funding Opportunities: Students highlighted interest in applying for scholarships and fellowships, including the NSF Graduate Research Fellowship

Program (GRFP), the Goldwater Scholarship, and institution-specific awards or scholarships connected to materials science.

- **Future Academic Pursuits**: Several participants connected their REU projects to longer-term academic goals, including pursuing graduate study in computational physics/chemistry and continuing Density Functional Theory work.
- **Other Funding/Support**: Mentions were made of external grants and awards already connected to their research, such as the ExpandQISE grant and Caltech SURF award.
- **Mixed Expectations**: A few students indicated that their summer work was not expected to lead to publication or was more connected to prior research rather than the REU project itself.

Overall, these responses demonstrate that students are leveraging their PARADIM REU projects for tangible academic and professional advancement—through presentations, publications, fellowships, and graduate school preparation—while also reflecting honestly on the limits of project scope for publishable outcomes.

Figure 2. As a result of this REU research experience, how likely you are to:



These questions focus on how the REU experience may have influenced your future goals and ambitions:

- Almost 70% of the interns are more likely to apply for an award or scholarship,
- Over 30% are more likely to pursue a PhD, and
- 15% are more likely to apply to a Master's program.

Student comments provided rich detail that substantiates the quantitative findings:

- **Exposure to Graduate-Level Research**
    - "Being in close vicinity to many PhD students and postdocs gave me valuable perspective on research life."
    - "Being around graduate students and a research environment has given me confidence I could pursue graduate school."
- **Shifts in Academic Focus**
    - "It made me realize that I wanted to keep my main focus in chemistry, but I am more open to computational methods now."
    - "This program helped me to find a passion for research and consider computational materials science for graduate school."
- **Confirmation of Existing Plans**
    - "I already had a goal of pursuing a PhD program, so my plans remain unchanged."
    - "I was already set on going to graduate school, and this experience reaffirmed that decision."
- **Enhanced Readiness**
    - "I feel better prepared to seek out future opportunities because of this REU."

Comments reveal that for many students, the REU did not create new graduate ambitions but **strengthened their confidence, clarified focus areas, and enhanced preparedness** for graduate study. A smaller group reported that the experience directly shifted their interests toward specific research fields or methods.

Mentorship

Each REU intern was paired with a mentor, typically a professor and a grad student. Overall, the vast majority of REU participants reported positively to their mentor/mentee experience.

- "*My mentor was extremely helpful when it came to explaining complex topics and guiding me on my research project. They were definitely a much needed and helpful assistance."*
- *"My mentor was wonderful. I could not have asked for a better one! We connected very well. He was extremely supportive, encouraging, and approachable, and he always pushed me to think deeper about the work I was doing. He also was always willing to give career advice and connect me with people to help further myself in my goals. Very sad that he is leaving due to funding issues, everyone deserves a a mentor like him!*

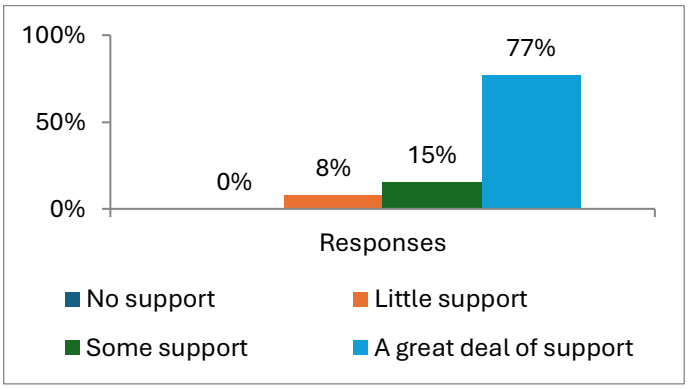
*In the survey, s*tudents weighed in on their perceptions of their mentor experience in three areas:

1. The degree of support received
2. The degree of a mentor's importance relative to the success of the REU experience
3. The degree to which a mentor influences an intern's future plans

Support Received

REU interns reported a high level of support, with 77% receiving "a great deal of support" and the remaining 15% receiving "some support" and 8% "little support" from their mentor. No participant reported receiving "no support" from their mentor.

Figure 3. Level of Support Received from Mentor in Preparation of Final Presentation



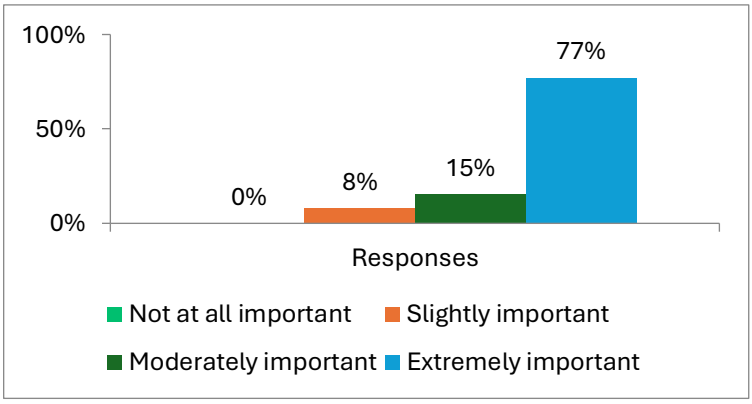
REU commentary offered a high degree of satisfaction with the mentor relationship. Most interns offered examples of their mentor/mentee relationship as being engaging, valuable and positive, some interns communicated appreciation for a more "hands off" approach:

- "I worked relatively independently from my mentor, meeting with him around once a week to show results, ask questions, and determine next steps. I felt that this provided a good balance of having a resource for guidance and also being able to problem solve independently."

Mentorship as a Cornerstone of the REU Experience

The majority (77%) of the REU interns felt that the mentor experience was integral to the success of the REU experience. (Figure 4) A review of survey data confirms the interns' view of a mentors importance relative to intern's experience as well as the overwhelming positive experience of the REU interns.

Figure 4. Importance of Mentor to REU Success



The survey responses strongly affirm that the quality of mentorship was one of the most impactful aspects of the 2025 PARADIM REU program. Students consistently described their mentors as not only teachers of technical skills but also as trusted advisors who shaped their confidence, academic direction, and professional outlook.

Several participants emphasized the extraordinary commitment of mentors to both their research and their personal development:

- *"My mentor Jacob Steel was a great support throughout the whole summer. He is a great teacher and advisor making learning and teaching fun all the way through."*
- *"Olivia did a fantastic job; she went completely out of her way to introduce me into this field where I had very little experience. She always made sure I wasn't too overwhelmed."*

Mentors also provided critical guidance in navigating complex research concepts and techniques:

- *"My mentor was extremely helpful when it came to explaining complex topics and guiding me on my research project. They were definitely a much-needed and helpful assistance."*
- *"My mentor teaches me almost all lab skills that I need for doing my research… He also shares his experience in the field of material science with me."*

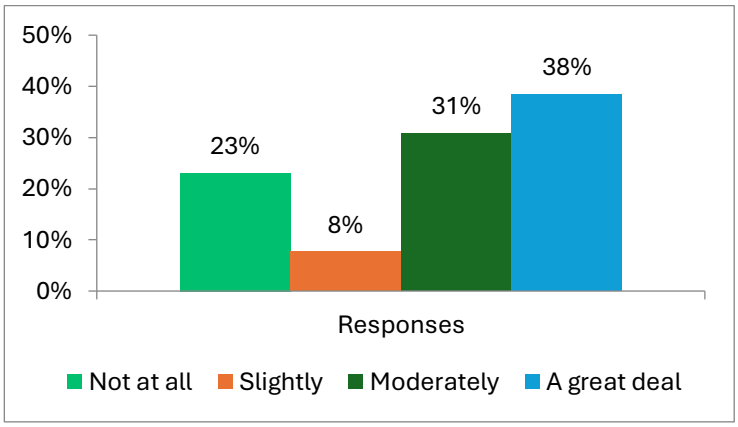
Mentor Influence

Interns were asked to rate their mentor's influence on their future plans. Close to 80% responded by acknowledging their mentor had a *moderate* to *great deal* (Figure 5.) of influence on their future planning. Approximately 20% reported being slightly influenced.

In addition to technical training, mentors extended their support to career preparation and graduate school planning:

- *"My mentor, Allana, was very passionate about helping me prepare for a future in grad school for materials science. She worked with me on fellowship applications and talked with me about what interests I have."*
- *"My mentor was wonderful. I could not have asked for a better one! We connected very well… He always pushed me to think deeper about the work I was doing, and was always willing to give career advice and connect me with people to help further myself in my goals."*

Figure 5. Mentor Influence on Intern's Future Plans



Students also highlighted the value of diverse mentorship models—ranging from individual guidance to group-based mentoring communities—each offering unique opportunities for growth:

- *"I greatly enjoyed my experience with my mentor(s)... I liked having this community of mentors, and their love for their projects, and science as a whole, made me excited for the project and my future academic plans."*
- *"I worked relatively independently from my mentor, meeting with him around once a week to show results, ask questions, and determine next steps. I felt that this provided a good balance of having a resource for guidance, and also being able to problem solve independently."*

Together, these reflections underscore that mentorship is a defining strength of the PARADIM REU program. Mentors not only enabled students to succeed in their summer projects but also inspired them to envision future pathways in science, graduate education, and professional development.

Survey Summary

Survey results demonstrate that the 2025 PARADIM REU program was highly successful in delivering a rigorous and supportive research experience for undergraduate participants. Students rated faculty and graduate/postdoctoral mentorship very positively, and the majority of lectures, workshops, and laboratory experiences were described as informative and impactful. The program fostered a strong sense of cohort belonging, with students highlighting the value of peer connections alongside their academic growth.

While feedback pointed to minor opportunities for improvement—such as refining the pacing of certain seminars and ensuring consistency across site-specific resources—the overall

evaluation reflects a well-structured program that met or exceeded student expectations. Participants reported meaningful gains in research skills, professional confidence, and exposure to materials discovery and characterization.

The findings affirm that the PARADIM REU remains a high-quality national research training program and provide a strong foundation for future cohorts. Continued attention to integrating student feedback into program design will further strengthen the impact of this unique interdisciplinary research opportunity.