Materials Connection REU Site (MacREU R'Side) Evaluation, 2015*

Kevin M. Esterling
UC – Riverside
kevin.esterling@ucr.edu

Ludwig Bartels
UC – Riverside
ludwig.bartels@ucr.edu

November 25, 2015

*This REU site is funded by a grant from the National Science Foundation (award number DMR 1359136).

Abstract

This is the evaluation for the second year of the MacREU-UCR REU site. Overall, the program performed very well in exposing students to science and engineering, building their scientific skills and encouraging them to pursue a PhD. As we report in the first evaluation, the program's first year had a number of organizational challenges; virtually all of these challenges were overcome in this year's program. This evaluation suggests a few more improvements that we can make for the next year's cohort.

1 Introduction

"Materials Connection REU" (MacREU R'Side) was a 10 week REU site in which 19 undergraduate students, mostly from Southern California colleges, had the opportunity to conduct research in science and engineering labs on the UCR campus in the summer of 2014. The students came from demographic groups that are under-represented in STEM fields, and were carefully selected among applicants as those who were at risk of not pursuing a career in science. The students home institutions are California State University Long Beach (x2), LA Pierce College, LA Trade Tech College, Norco College, Riverside City College (x3), University of LaVerne (x2) , University of Massachusetts Amherst, University of Millersville, UC Berkeley. UCR (x5), and Wellesley.

All of the students' research projects were related to the growth and application of thin films or monolayer materials. Students were placed in a variety of labs within the Materials Science and Engineering program. Participants are exposed to a wide area of fields from catalytic chemistry to semiconductor processing and from solar cell manufacture to the improvement of medical devices. To learn more about the MacREU site at UCR, visit http://macreu.ucr.edu/. At this site, one can view short video presentations from each of the students that describes their research and experience in the program.

This evaluation draws on two data sources 1) a survey of participating students based on the REU survey template available on the "Student Assessment of Learning Goals" website http://salgsite.org, providing both qualitative and quantitative evaluation data; and 2) qualitative responses from the participating students provided orally in a end of program meeting.

Overall, the second year of the program well met its academic goals of exposing students to research, building their academic research skills, and gaining their interest in pursuing science and engineering as a career at the PhD level. The previous year's cohort (MacREU 2014) provided feedback on ways to improve organizational aspects of the program, and it appears many of the first year's growing pains have been resolved. In virtually every measure in this evaluation, the 2015 program exceeded the results we observed from the 2014 program. In sum, the program was a strong success and met its goals of instilling an interest in science and engineering among students from under-represented backgrounds.

2 Student Assessment of Learning Goals Survey Results

In this section, we present the results of a survey we administered to the 19 participating students, and 17 of these students filled out a survey. The survey comes from a template for REU evaluations available at the Student Assessment of Learning Goals website. We used this website to administer the survey and to generate the figures showing results.

Overall, the program well met its goals of introducing students to scientific research as a career and helping them to build capacity for conducting scientific research. This can be seen for example in Figure 1. In this section of the survey, students were asked to rate their own gains from the program in learning how to think scientifically and work like a

Gains in THINKING AND WORKING LIKE A SCIENTIST: APPLICATION OF KNOWLEDGE TO RESEARCH WORK.

1. How much did you GAIN in the following areas as a result of your most recent research experience?	1:no gains	2:a little gain	3:moderate gain	4:good gain	5:great gain	9:not applicable	Mean	N
1.1 Analyzing data for patterns.	0%	0%	0%	10%	47%	0%	4.8	17
1.2 Figuring out the next step in a research project.	0%	0%	0%	17%	40%	0%	4.7	17
1.3 Problem-solving in general.	0%	0%	0%	10%	47%	0%	4.8	17
1.4 Formulating a research question that could be answered with data.	0%	3%	3%	13%	37%	0%	4.5	17
1.5 Identifying limitations of research methods and designs.	0%	3%	0%	7%	47%	0%	4.7	17
1.6 Understanding the theory and concepts guiding my research project.	0%	0%	3%	13%	40%	0%	4.6	17
1.7 Understanding the connections among scientific disciplines.	0%	0%	3%	7%	47%	0%	4.8	17
1.8 Understanding the relevance of research to my coursework.	0%	0%	7%	10%	40%	0%	4.6	17

Summary of scale results

The graphic below lists the mean and confidence interval (±3 times the standard error) for each item.

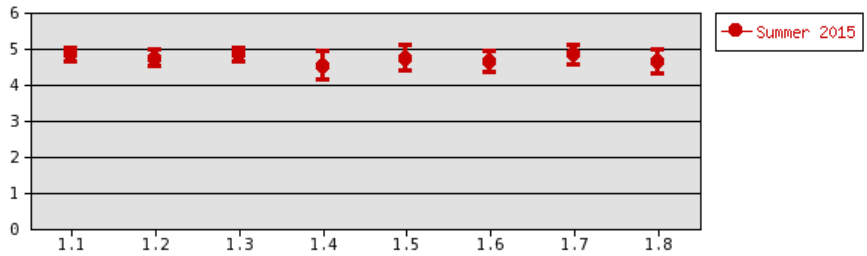


Figure 1: Gains in Thinking and Working Like a Scientist

scientist, and to apply scientific knowledge to research. On average, students report good to great gains in skills such as analyzing data for patterns, formulating a research question and understanding theory and concepts. while there is a little variability in responses, virtually all students report great gains in developing this capacity such that each of the confidence intervals exceeds the good category. This shows an improvement compared to year 1's responses on these items, in which many of the confidence intervals overlapped the good category.

Likewise, in figure 2 students reported considerable personal gains in their own capacity to do research, in areas such as their own ability to contribute to science, their confidence to do well in future science courses, and understanding what everyday research is like. Like in Figure 1, in no case did a confidence interval around a question mean include only a good level of gain response, and again showing an improvement over year 1.

Figure 3 also presents considerable evidence that students improved their professional skills such as how to prepare a scientific poster, keeping a detailed lab notebook and understanding journal articles. Students tend to report good gains in these skills across the board.

PERSONAL GAINS RELATED TO RESEARCH WORK

2. How much did you GAIN in the following areas as a result of your most recent research experience?	1:no gains	2:a little gain	3:moderate gain	4:good gain	5:great gain	9:not applicable	Mean	N
2.1 Confidence in my ability to contribute to science.	0%	0%	3%	17%	37%	0%	4.6	17
2.2 Comfort in discussing scientific concepts with others.	0%	0%	0%	7%	50%	0%	4.9	17
2.3 Comfort in working collaboratively with others.	0%	0%	0%	17%	40%	0%	4.7	17
2.4 Confidence in my ability to do well in future science courses.	0%	0%	0%	13%	43%	0%	4.8	17
2.5 Ability to work independently.	0%	0%	0%	20%	37%	0%	4.6	17
2.6 Developing patience with the slow pace of research.	0%	0%	0%	17%	40%	0%	4.7	17
2.7 Understanding what everyday research work is like.	0%	0%	0%	7%	50%	0%	4.9	17
2.8 Taking greater care in conducting procedures in the lab or field.	0%	0%	0%	7%	50%	0%	4.9	17

Summary of scale results

The graphic below lists the mean and confidence interval (±3 times the standard error) for each item.

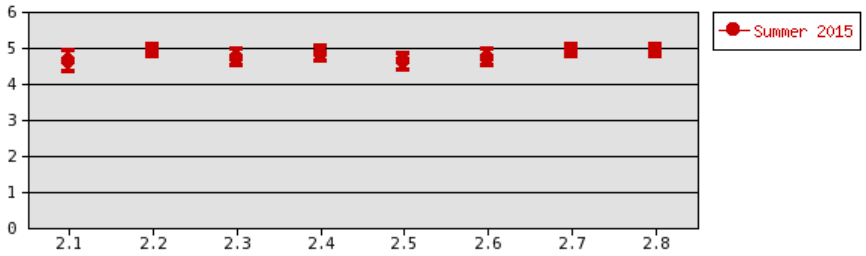


Figure 2: Personal Gains Related to Research Work

Figure 4 continues to support the view that students gained in their self-efficacy for conducting research, where students typically indicated their gained a fair amount or a great deal in their own feelings of efficacy in engaging in real-world science research, feelings of responsibility for their research project, feeling part of the scientific community, confidence in their own ability to try out new ideas or procedures on their own and interacting with scientists from outside of the school.

Overall, students rated the quality of their research experience as very good, including their working relationships with their research mentor, the amount of time doing meaningful research and the overall experience, and the amount of time spent with their mentors and getting advice from their mentors about graduate schools. The questionnaire also give students an opportunity to add more thoughts on the quality of their research experience and they wrote as follows.

- I truly enjoyed my experience and hope that others do in the future.
- Engaging with a fellow graduate students did an excellent job at preparing us for the expectations of graduate school and whether or not we were capable of it.
- My research group was extremley helpful throughout the internship. I enjoyed the

Gains in SKILLS

3. How much did you GAIN in the following areas as a result of your most recent research experience?	1:no gains	2:a little gain	3:moderate gain	4:good gain	5:great gain	9:not applicable	Mean	N
3.1 Writing scientific reports or papers.	0%	7%	13%	17%	20%	0%	3.9	17
3.2 Making oral presentations.	0%	0%	3%	17%	37%	0%	4.6	17
3.3 Defending an argument when asked questions.	0%	7%	3%	23%	23%	0%	4.1	17
3.4 Explaining my project to people outside my field.	0%	0%	7%	17%	33%	0%	4.5	17
3.5 Preparing a scientific poster.	0%	0%	3%	23%	30%	0%	4.5	17
3.6 Keeping a detailed lab notebook.	0%	3%	3%	27%	23%	0%	4.2	17
3.7 Conducting observations in the lab or field.	0%	0%	0%	27%	30%	0%	4.5	17
3.8 Using statistics to analyze data.	0%	7%	17%	13%	20%	0%	3.8	17
3.9 Calibrating instruments needed for measurement.	0%	3%	13%	13%	23%	3%	4.1	16
3.10 Working with computers.	0%	7%	13%	10%	27%	0%	4.0	17
3.11 Understanding journal articles.	0%	0%	3%	30%	23%	0%	4.4	17
3.12 Conducting database or internet searches.	0%	3%	3%	20%	30%	0%	4.4	17
3.13 Managing my time.	0%	0%	7%	23%	27%	0%	4.4	17

Summary of scale results

The graphic below lists the mean and confidence interval (±3 times the standard error) for each item.

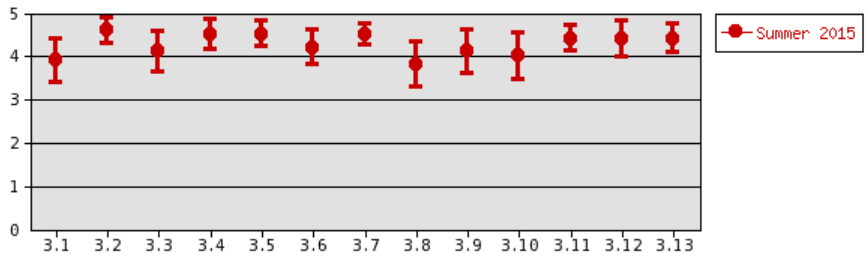


Figure 3: Gains in Academic Skills

one-on-one interaction and I liked being assigned one grad student. The grad student mentor Gabe me an insight on what to expect for graduate school.

- It was all good.
- Had a good relationship with my mentor.
- My mentor was changed at the last minute and I ended up with a great mentor. Sina taught me a lot and his help to my project was priceless.
- I truly enjoyed working with my lab
- My research experience was above all excellent in the sense that all of my mentors were very helpful and guided me throughout this process.
- Though my research mentor was completely swamped by personal and professional obligations, he still managed to be a good mentor and assist me on completing

The following questions ask about your overall research experience and about any changes in your attitudes or behaviors as a researcher.

4. During your research experience HOW MUCH did you:	1:none	2:a little	3:some	4:a fair amount	5:a great deal	9:not applicable	Mean	N
4.1 Engage in real-world science research	0%	0%	0%	3%	53%	0%	4.9	17
4.2 Feel like a scientist.	0%	0%	0%	3%	53%	0%	4.9	17
4.3 Think creatively about the project.	0%	3%	3%	7%	43%	0%	4.6	17
4.4 Try out new ideas or procedures on your own.	0%	3%	3%	17%	33%	0%	4.4	17
4.5 Feel responsible for the project.	0%	0%	7%	10%	40%	0%	4.6	17
4.6 Work extra hours because you were excited about the research.	0%	0%	3%	17%	37%	0%	4.6	17
4.7 Interact with scientists from outside your school.	0%	3%	3%	23%	27%	0%	4.3	17
4.8 Feel a part of a scientific community.	0%	0%	3%	10%	43%	0%	4.7	17

Summary of scale results

The graphic below lists the mean and confidence interval (±3 times the standard error) for each item.

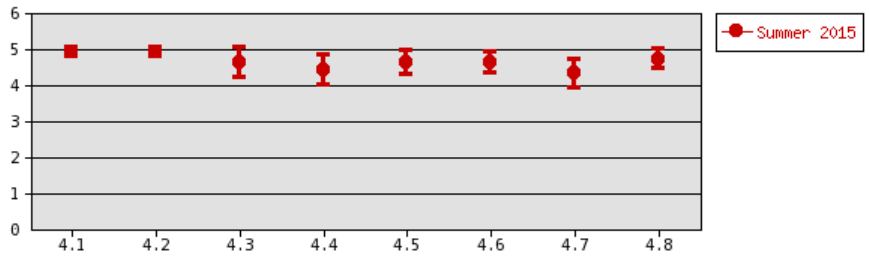


Figure 4: Attitude and Behavioral Changes

my goals on time. Though he was a knowledgeable and patient teacher, for future mentors I would suggest using availability as part of the criteria for picking a mentor.

- My mentor did not really have time for me and was also a grad student. She seemed too busy and irritable.

- My research mentor was not as organized as he should be. Considering he had 2-3 other undergraduate students under his supervision, it had seemed that the tasks he had assigned me with were things I could have done in any general Biology or Chemistry course. It was not as in depth of a research assignment as I thought as it should be. I then proceeded to work with another Graduate Student (while still working with my initial mentor) which turned out much better than my first. The choice to work with another graduate student has significantly enhanced my experience with MacREU. I believe that with the proper mentor and guidance, this program will prove to be quintessential for any undergraduate student wanting to pursue a career in the sciences.

Figure 6 summarizes the research communication activities students participated in. The program expected students to prepare a scientific poster as a part of the program,

These questions ask about your research experience.

5. Please rate the following:	1:Not applicable	2:Poor	3:Fair	4:Good	5:Excellent	Mean	N
5.1 My working relationship with my research mentor	0%	7%	7%	13%	30%	4.2	17
5.2 My working relationship with research group members.	0%	0%	3%	10%	43%	4.7	17
5.3 The amount of time I spent doing meaningful research.	0%	0%	3%	27%	27%	4.4	17
5.4 The amount of time I spent with my research mentor.	0%	7%	13%	10%	27%	4.0	17
5.5 The advice my research mentor provided about careers or graduate school.	0%	3%	7%	23%	23%	4.2	17
5.6 The research experience overall.	0%	0%	3%	17%	37%	4.6	17
5.7 Please comment on any of these aspects.	Enter codes for text answers					--	11

Summary of scale results

The graphic below lists the mean and confidence interval (±3 times the standard error) for each item.

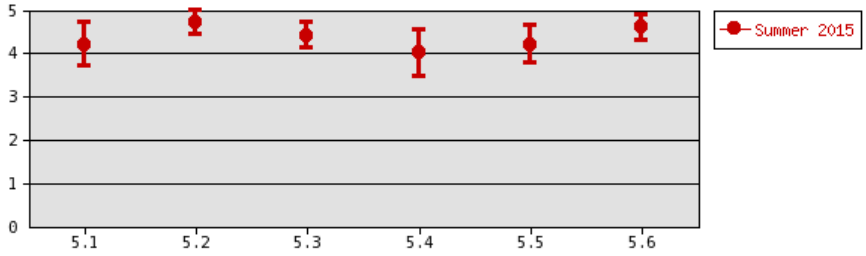


Figure 5: Quality of Research Experience

and most of them indicated that they either presented the poster or planned to present it. The program did provide students an opportunity to prepare a talk, but they did not have the opportunity to attend a conference or publish a paper during the summer session, but the large majority plan to do these activities subsequently.

Figure 7 continues to lend support to our belief that the program enhanced students' interest in science and engineering as a career, typically indicating that the program confirmed and clarified their scientific career interests.

Figure 8 also confirms that the program enhanced students' expectations and interests in pursuing research and science as a career, indicating gains in interest in enrolling in a STEM PhD or masters' program and working in a science lab. The program did not enhance students' interest in medical, dental or law school which is expected. This figure overall indicates both the effectiveness of the program in enhancing students' interest in science and also that the program did not typically select students already on the science track, since if students entered program on a science career track they also would have indicated no gains.

The questionnaire also asked them to type in their intended degree and, "compared to your intentions BEFORE doing research, HOW LIKELY YOU ARE NOW to enroll in a graduate program leading to an advanced degree."

Research experience

6. As part of my most recent research experience...	1:yes	2:no	Mean	N
6.1 I presented a talk or poster to other students or faculty	53%	3%	–	17
6.2 I presented a talk or poster at a professional conference	10%	47%	–	17
6.3 I attended a conference	10%	47%	–	17
6.4 I wrote or co-wrote a paper that was published in an academic journal	7%	50%	–	17
6.5 I wrote or co-wrote a paper that was published in an undergraduate research journal	3%	53%	–	17
6.6 I will present a talk or poster to other students and faculty	50%	7%	–	17
6.7 I will present a talk or poster at a professional conference	57%	0%	–	17
6.8 I will write or co-write a paper to be published in an academic journal.	33%	23%	–	17
6.9 I will write or co-write a paper to be published in an undergraduate research journal.	23%	33%	–	17
6.10 I won an award or scholarship based on my research	0%	57%	–	17

Figure 6: Research Activities

- Before doing research, I had planned to pursue a masters in Chemical Engineering, and now I still plan on pursuing a masters degree.
- My intended degree is B.S in physics. I plan on pursuing an advance degree in physics applying those principles to material science.
- I think I'd like to get a phD even more now that I see what the life of a grad student is like.
- Want to pursue MSE PhD whereas before, I did not intend to go to graduate school.
- Behavioral Neuroscience
- Disregarding the problems with my mentor, the exposure this program had given me reaffirmed my interest in research. I appreciated every aspect of it.
- I intend to enroll in a graduate program.
- I am absolutely convinced that graduate school is right for me, as I have decided to pursue a Ph.D in MSE or Physical Chemistry.
- I have always been interested in lab research but never had the opportunity to experience being part of a research group. MacREU provided the experience I desired and it has ensured that I want to pursue a MD/PhD. I enjoyed the hands on experience very much.

Research experience

7. Rate how much you agree with the following statements.	1:Strongly disagree	2:Disagree	3:Agree	4:Strongly agree	Mean	N
7.1 Doing research confirmed my interest in my field of study.	3%	0%	17%	37%	3.5	17
7.2 Doing research clarified for me which field of study I want to pursue.	0%	3%	13%	40%	3.6	17
7.3 My research experience has prepared me for advanced coursework or thesis work	0%	3%	20%	33%	3.5	17
7.4 My research experience has prepared me for graduate school.	0%	0%	20%	37%	3.6	17
7.5 My research experience has prepared me for a job.	0%	3%	23%	30%	3.5	17

Summary of scale results

The graphic below lists the mean and confidence interval (±3 times the standard error) for each item.

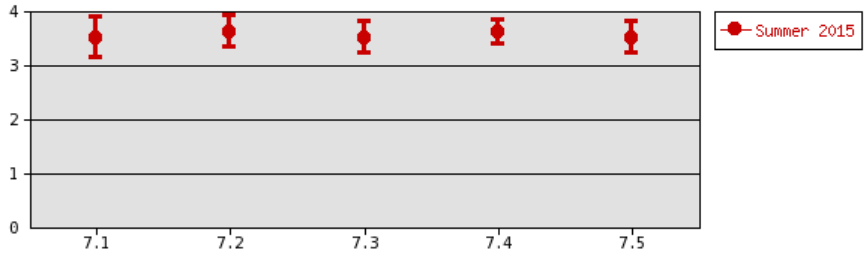


Figure 7: Effects of Research Experience on Personal Advancement

- The experienced confirmed for me that I wanted to pursue a degree that would allow me to do cutting edge research.
- Before doing research, my intended degree was M.D. After research, it continues to be M.D, but now I am considering a Ph.D as my back up plan. So the chances of enrolling into a graduate program is much more likely. This research experience has affirmed my confidence in being able to succeed in the pursuit of my Ph.D. I intend to enroll in a doctorate program for theoretical and computational chemistry.
- Before doing research, my intended degree was Materials Science and Engineering and after research, it is still the same. I am much more likely to enroll in a phD program in an engineering discipline.
- I am definitely pursuing a Masters in my chosen field of study. I might go for a Ph.D but will decide in the next year. Before research I only intended on pursuing a 4-year degree or forgoing college altogether because I am already employed in the family business. The program really opened my eyes to the opportunities out there in regards to higher education.

The questionnaire included an open-ended question asking students to reflect on how their research experience influence their own thinking about future career and graduate school plans. The students wrote,

Research experience

8. Compared to your intentions BEFORE doing research, HOW LIKELY ARE YOU NOW to:	1:not more likely	2:a little more likely	3:somewhat more likely	4:much more likely	5:extremely more likely	9:not applicable	Mean	N
8.1 enroll in a Ph.D. program in science, mathematics or engineering?	3%	0%	0%	17%	37%	0%	4.5	17
8.2 enroll in a masters program in science, mathematics or engineering?	7%	0%	7%	13%	20%	10%	3.9	14
8.3 enroll in a combined M.D/Ph.D program	10%	0%	7%	3%	27%	10%	3.8	14
8.4 enroll in medical or dental school?	20%	0%	0%	0%	13%	23%	2.6	10
8.5 enroll in a program to earn a different professional degree (i.e. law, veterinary medicine, etc.)	20%	3%	3%	0%	3%	27%	1.8	9
8.6 pursue certification as a teacher?	23%	3%	7%	3%	7%	13%	2.2	13
8.7 work in a science lab?	0%	0%	7%	13%	37%	0%	4.5	17
8.8 Other. Please state your intended degree and, compared to your intentions BEFORE doing research, HOW LIKELY YOU ARE NOW to enroll in a graduate program leading to an advanced degree.	Enter codes for text answers						--	16

Summary of scale results

The graphic below lists the mean and confidence interval (±3 times the standard error) for each item.

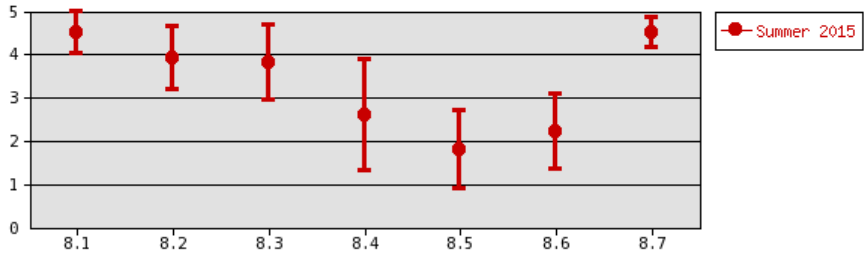


Figure 8: Effect of Experience on Entering the Pipeline

- This research experience made my plans for graduate school much more realistic and tangible. Applying to graduate school doesn't seem so far away now. It also reaffirmed my desire to stay in the chemistry/chemical engineering fields.
- This research has given me the confidence in my ability to perform in research settings.
- Graduate school seems more doable and exciting to me.
- I learned that I am not interested in my current field of study and will pursue a graduate degree in a different field.
- Made me think about what type of experiments I'd like to work on
- MacREU has given me both reaffirmation and motivation towards my pursuit of a career in science. It has also given me the confidence to truly seek out my passion and has been a vital stepping stone for my path towards my future career.

- Before starting this program I was on the fence about graduate school. I thought I didn't have what it takes but after my experience this summer it has helped me see that I can do this.
- This research opportunity has geared me for graduate school and even inspired some possible ideas for a thesis during the doctorate program.
- My research experience encouraged me to explore biomedical research. Although the research group I was assigned had nothing to do with biomedical research, I enjoyed the process of conducting research. Also, my grad mentor provided information on graduate school and my undergraduate studies. My grad mentor had the same major as me and she offered great advice to become successful in the classes. Overall, the research experience was extremeley helpful and I have met individuals that provided resources for my future goals.
- It helped me to feel more confident that the path I chose was the right one and of my own capabilities.
- Before doing research, my intended degree was M.D. After research, it continues to be M.D, but now i am considering a Ph.D as my back up plan.
- I wan't to continue to do research in a graduate program and continue to do active research in my field. The research experience helped me explore the scientific community and become more aware of the opportunities available to me.
- It provided with me a broader understanding about the field of chemistry I want to join.
- My research experience paved my future for the next 6 years. I know plan on pursuing a PhD in electrical engineering and I am very excited to do so.
- This experience definitely gave my a glimpse of what the lifestyle of a graduate student is. I am very happy to know that I live in a country with so many opportunities in terms of academia for underrepresented students. I will be pursuing a graduate degree.
- I plan on remaining in research for the rest of my time at UCR. I plan on advancing on in graduate school to either a masters in management science & engineering or a masters in business

The questionnaire also asked students to reflect on other ways the program enhanced their interest in science as a career and led to personal gains, and they wrote,

- It made me realize that material science is an exciting field that I plan on exploring in graduate school.
- I learned how to collaborate with people.
- I established a professional network.

- I gained an understanding of how to work with various people and network
- I love how some (though not all) graduate students are willing to sit down and teach you everything about their research. That inclusion has allowed me to feel like I am part of a community working for a greater goal. This has given me extra confidence because of their patience and belief in me to perform certain tasks.
- I have greatly expanded my understanding of machining, handiness, and electrical maintenance. These are assets that I didn't know I desired and would've otherwise not had the opportunity to learn.
- I also gained networking opportunities not only within the MacREU program but with other summer internship students.
- I gained professionalism and work ethics.
- I learned how to solve problems by collaboration with other researchers. I also gained experience in identifying bad research from good research and applying the scientific method to everything I do in the lab.
- Alongside figuring out my plans for the next couple of years, this 10 week REU program made me a better public speaker and has allowed me to present my work to a general public.
- One of the big things that I liked about my experience with Mac Reu was the connection and rapport I was able to build with my grad mentor and PI. I was able to further develop professional skills such as public speaking and presentation techniques.

The following questions ask about aspects of the research program.

11. How satisfied were you with the following aspects of the research program?	1:Not applicable.	2:Very dissatisfied	3:Somewhat dissatisfied	4:Somewhat satisfied	5:Very satisfied	Mean	N
11.1 The application process.	0%	0%	7%	23%	27%	--	17
11.2 Support and guidance from program staff.	0%	0%	0%	13%	43%	--	17
11.3 Support and guidance from my research mentor.	0%	0%	7%	13%	37%	--	17
11.4 Support and guidance from other research group members.	0%	0%	0%	20%	37%	--	17
11.5 Research group meetings.	0%	3%	3%	17%	33%	--	17
11.6 Financial support.	0%	0%	7%	17%	33%	--	17
11.7 Group social activities.	0%	0%	10%	30%	17%	--	17

Figure 9: Satisfaction with the Program

Figure 9 indicates that students overall were satisfied with the organization and structure of the program itself. These scores are a strong improvement over last year's evaluation, in which students gave relatively low marks to support and guidance from the

program staff, few research group meetings and lack of social activities. We readily admit that the first year of the program was a learning experience for the PIs and we took care to work with the program staff to improve the program. In particular, we included better training and involvement with lab personnel; we hired a staff person (Velveth Klee) who was able to provide constant attention to the group training and activities, and more planned social activities.

Training Sessions

12. How MUCH did the following activities support your learning?	1:Did not do this activity	2:Not at all	3:A little	4:A good amount	5:A great deal	Mean	N
12.1 Workshop(s)on science writing and presentation.	0%	0%	10%	20%	27%	--	17
12.2 Training in library/internet/database search methods.	0%	10%	10%	17%	20%	--	17
12.3 Safety training	0%	3%	7%	17%	30%	--	17
12.4 Ethics seminar(s)	0%	3%	10%	20%	23%	--	17
12.5 Training in human or animal subjects regulations.	3%	3%	17%	20%	13%	--	17

Figure 10: Gains from Professional Training

Figure 10 also indicates mixed views of the training offered, although in each case students typically report gaining a good amount or a great deal of learning from each program element. This might be an area for future improvement, although there is only so much training students can do over the course of a 10 week program.

How did you find out about research opportunities on campus?

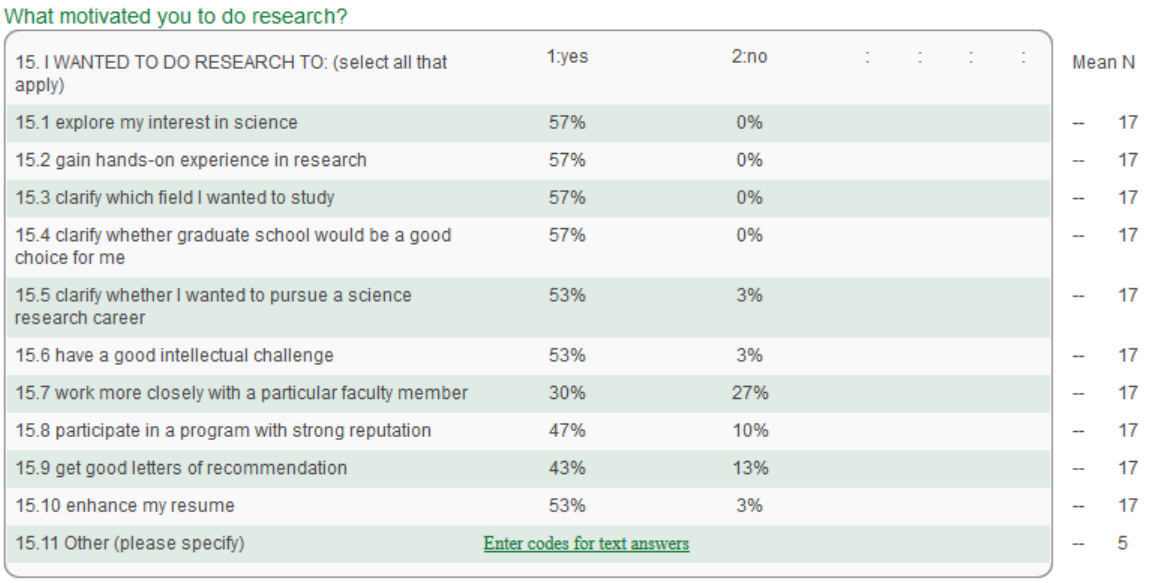
14. I found out about research opportunities from:	1:yes	2:no	Mean	N
14.1 I knew this institution offered research opportunities to undergraduates before coming here	23%	33%	--	17
14.2 in class	13%	43%	--	17
14.3 an academic advisor	13%	43%	--	17
14.4 an announcement (flyer, poster, email, website, etc.)	23%	33%	--	17
14.5 a presentation given by professors or students about their research	20%	37%	--	17
14.6 Other (please specify):	Enter codes for text answers		--	8

Figure 11: Ways to Learn about Research Opportunities on Campus

Figure 11 indicates that students learn about research opportunities such as MacREU from a variety of sources. Students also indicated other sources for this information in an open ended question, including two that learned of the program from the previous year's participants:

- Friends who were in labs.

- I got recommended to this program by my old chemistry professor and my friend
- A colleague who had previously participated in this program last year.
- My community college had a recent MacREU student speak at our school about his experience.
- On the NSF REU website
- A grad student recommended that i applied.
- I learned about the program through an academic advisor/professor/mentor at my community college. I also heard about it at the SACNAS conference.



What motivated you to do research?

15. I WANTED TO DO RESEARCH TO: (select all that apply)	1:yes	2:no	Mean	N
15.1 explore my interest in science	57%	0%	--	17
15.2 gain hands-on experience in research	57%	0%	--	17
15.3 clarify which field I wanted to study	57%	0%	--	17
15.4 clarify whether graduate school would be a good choice for me	57%	0%	--	17
15.5 clarify whether I wanted to pursue a science research career	53%	3%	--	17
15.6 have a good intellectual challenge	53%	3%	--	17
15.7 work more closely with a particular faculty member	30%	27%	--	17
15.8 participate in a program with strong reputation	47%	10%	--	17
15.9 get good letters of recommendation	43%	13%	--	17
15.10 enhance my resume	53%	3%	--	17
15.11 Other (please specify)	Enter codes for text answers		--	5

Figure 12: Motivations to do research

Figure 12 shows that students report a wide range of motivations for participating in research. The questionnaire also provided students an open-ended question to report motivations they have to do research. Not many students responded to the question, but the ones that did respond wrote as follows:

- To reaffirm my profound interest in the sciences.
- I also wanted to get experience that would help me develop as a scientist and influence my thoughts on possible graduate research projects.
- Clarify if a lab setting is a fit for me.

Students were also given the opportunity to reflect on how the program impacted their career plans, and they wrote as follows (some of the responses seem that they would be a more appropriate response to the next question about how to make the experience better, but I am keeping these responses here). Typically the on-point responses were quite positive.

- The workshops were a perfect supplement to the program. The additional learning experiences in these sessions allowed me to truly look and understand that the working in the lab goes beyond the research. It also encompasses a code of ethics and the social setting of the laboratory.
- Although helpful, this activity should be shorter, earlier in the program, and a selection of graduate students more relevant to the REU students.
- They were very informative and should continue to be offered.
- The graduate student panel was very helpful with questions for the graduate school application process.
- Making the talks optional would be better.
- The information sessions with panelists from non stem related fields was not very helpful. There needs to have been more structure to the talk.
- The graduate student panel was very helpful

Students also were given an opportunity to write suggestions on how to make the program experience better (and in this vein we should add the first and second to last response from the previous list here).

- I would've liked to have more of a choice in which lab I worked in. Although I immensely enjoyed working in my lab, I would've liked to have been in a lab more related to my future career plans.
- I think one group activity a week to foster friendship would have been greatly appreciated.
- There was group drama a lot. It would have been nice to not have been involved in this.
- Having graduate students that were more available and responded to my emails/messages more consistently.
- If my mentor would have allowed me to brain storm ideas about how to approach my research instead of him just telling me what to do.
- A more hands-on mentor who is organized and allowed undergraduate students to perform significant experiments (given proper training).

- A possible allocation of funds for materials specific to the undergraduates' direct project, since resources can sometimes impede progress.
- I know conferences are sometimes inevitable but I would have liked if my research group was not absent for more than a couple of days. At times, my research group would leave for a week or so for conferences. I do want to point out that when they were in the lab, they were extremely helpful but I feel like I could have gained more if they were not gone for long periods at a time.
- Nothing. It was great.
- Having a more class-like GRE training; including weekly quizzes, homework from the book, etc.
- More time. I was sad to have it end.
- Making the program longer would be excellent.
- I believe having less seminars such as every Thursday would have made this experience a little more desirable. The 10 week research experience was intellectually stimulating and I am thankful for that.
- I had a great experience. Many of my colleagues did not. Talking with them I learned that the thing that could have enhanced their experience would have been having contact with their PI and grad mentor prior to the first day. I understand that we could have communicated through email, but I feel that person to person is better when trying to build rapport.
- A more interactive mentor

And students were asked an open-ended question on how to make the experience better overall.

- I had a really great graduate student mentor, but I know that not all of the program participants felt the same way. I believe that there should be a more careful selection of the graduate student mentors so that all of the participants get along with and enjoy working with their mentors.
- It was overall pretty good, thank you.
- Having field trips during the week (not on the weekend)
- If they offered the research conference there at UCR
- A selection and interview process of mentors assigned to undergraduate students will help improve the experience of this program significantly to those participating.
- Some preview of the research topics and up to date projects for the labs might help prepare undergraduates for their research.

- I would recommend to hold social gatherings in the beginning of the program so the students can get to know one another sooner. There were a couple of students I seldomly spoke to throughout the program. Also, if it is possible to have someone like Ashley a bit sooner. Ashley was very helpful and it would you been nice to get more help from her sooner in the program.
- Fieldtrips
- Everything was fine.
- An increase in stipend funds for students who had to commute. Reimbursements for mileage would have put financial concerns to rest and allow for students to focus more on research and not on how they will get to campus.
- Having the option of meeting your mentor before the program starts.
- Having more time with the professors to talk about your graduate school plans.
- Having more outings during the week, as a whole group. I feel that doing that could have enhanced everyones experience. Some people confessed to me that they felt excluded. One outing as a group could have established a great rapport in the beginning of the program.
- Smaller more frequent assignments and updates in order to keep us on track.

3 End of program meeting with students

The PI and co-PI, along with the program administrator, met with students to get their feedback on how to improve the program. The students mentioned:

- Provide an online storage for students to access GRE and workshop materials
- Free breakfast is good - more cheese danishes.
- Student/mentor selection - students prefer graduate students over post docs (must ensure graduate students are mentors!) one-on-one relationship when possible (graduate mentor with several undergraduate mentees not preferred). Set research work expectations (work hours) for reu students. if possible, have graduate students available for 10-week period (not so much travel).
- Graduate panel earlier on in the program. graduate panel in-house for MacREU participants only with engineering/chem/phys mentors.
- Workshops with more interactive involvement, hands-on experiences.
- Ashley/writing super helpful!
- Admissions Dean - Dr. Sharon Walker - excellent workshop, most helpful of all workshops.

- Access to MSRIP/workshop slides.
- Mid-term/Final symposium was a great experience, provides more confidence and preparation. More public speaking opportunities would be helpful.
- Elevator speeches learned/practiced during the GRE workshop was very helpful. Students would have liked this done earlier on in the program.
- During first few weeks, a workshop on communicating with labmates and navigating lab politics would be helpful (especially early on).
- Early on, provide students with opportunity to give us feedback of their lab experience - is their lab selection working or not for them?
- Students liked having another reu student in the same lab.
- Living in the International Village was a great experience, students were impressed by the facilities. Students concerned over safety at night when walking, especially walking at night back from ucr, specifically on university before entering the extension center. if possible, get ucr student ID cards for access to P2P.
- Any help covering parking costs or gaining access/permits to closer parking lots.
- Reimburse commuters for parking and/or mileage. Housing students are given housing.
- A full-day field trip scheduled into the 10 week program to a science facility. Specifically, the trip should be scheduled during the week M-F.
- Late stipend payments always an issue. Look into paper checks instead of direct deposit for ucr students. Direct deposit delayed ucr students disbursement.
- GRE practice tests more often and homework assignments.
- GRE more math practice. Students enjoyed math more.
- GRE - students really liked and responded to games. Enjoyed studying for the verbal exam through games and helped with remembering vocab. Students liked being placed into teams for the 10week period.
- GRE full length test 1-2 times per week (at least one required with advance notice).
- The Google calendar is much better as a point of information than twitter.
- Provide students with any MacREU apparel or UCR items for spirit.

4 Conclusion

Overall, the program was very successful in its goals of interesting students in a career in science and engineering, in equipping them for such a career, and providing with strong research experience and skills. Furthermore, the evaluation scores for this year were higher across the board compared to last year, and especially on the organizational dimensions. Some of the improvements were stating clearer expectations on how they are to communicate their research, doing a mini-conference and a mid-program conference where students presented their research orally to each other, enhanced staffing, focusing on grad students as lab mentors and offering these grad students some training on the program's goals, more planned social activities, and better planning around bureaucratic glitches. We look forward to building on this evaluation and even improving MacREU even more in 2016.