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BOARD # 307: University of Arkansas Biomedical Engineering REU Site: Training in Emerging Biomedical Optics and Imaging Approaches

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REU Site: Training in Emerging Biomedical Optics and Imaging Approaches

Background

The NSF-funded Biomedical Optics and Imaging REU program (award number EEC #2243953) was initiated in Summer 2023 to primarily recruit students from regional schools with strong undergraduate programs in biology or related areas that lack a graduate program in biomedical engineering. Through this REU site, students were paired with faculty mentors to work on a range of individual, hypothesis-driven projects which apply or develop state-of-the-art biomedical imaging methods and techniques. Students also received a range of lectures on professional development topics, social activities, and the experience culminated in each student submitted an abstract to present at the Biomedical Engineering Society Annual Meeting [1-3]. A major goal of this program is to enhance students' research skills, as well as to build a sense of belongingness and improve retention within the field of biomedical engineering [4-6]. To evaluate students' experience in our REU program, an external evaluator was used to conduct a survey and assessment of what was learned. This survey was performed using open-response and five-point Likert-scale questions, and relevant data are shown throughout this manuscript.

Student Recruitment

In Summer 2023, the first year of the program, seven students (3 female, 4 male) submitted and presented their abstracts at the BMES conference in Seattle, WA. Most students were recruited from a range of regional institutions, with one student attending from Stanford University. The students were asked about their participation in research prior to attending the Summer REU. The results show a fairly even distribution of research experience with two having no prior experience and two others with significant experience.

Response Option	Count of Students
Never participated	2
1 semester	1
2 semesters	1
3 semesters	1
4 or more semesters	2

Campus Research Activities

Students were asked to briefly describe their REU research projects. Their responses are included verbatim below:

- "I would be observing the effects of the twist-1 gene on breast cancer cells by comparing the results with normal functioning twist-1 gene and cells with the deletion of the gene. The difference between two-photon microscopy was applied."
- "I was involved in a project testing the effects of Quercetin on senescent cell populations. I also tested the effects of Quercetin on stem cell differentiation."
- "I trained a convolutional neural network to segment cells in fluorescence images."
- "I optimized the procedure for the development of collagen I hydrogels for disease modeling."
- "I did work with lipid nanoparticle synthesis using a syringe pump system."
- "I worked on a project investigating the role of the NFKB signaling pathway in macrophage polarization. Used genetics and imaging techniques to this end."
- "I did research using an injury model of a mouse with volumetric muscle loss. I did spatial transcriptomic analysis on the injury site."

In addition to research-project specific training performed between the REU participant and faculty mentor summarized above, all REU participants participated in a Biomedical Engineering faculty-let professional

development and bioethics lecture series. Topics covered by this lecture series included experimental design and statistics, data management, manuscript authorship and ethical considerations, scientific writing and presentation development, human subject and animal research ethics, and graduate and medical school career guidance. Additionally, students participated in campus-wide social events including tours of campus and Northwest Arkansas, a game night at Arvest Ballpark, "Dinner and Dialogue" seminars and other events designed to bolster students' sense of belonging and camaraderie.

Large majorities of the students (5-6 out of the 7) reported Large or Very Large gains in acquiring new laboratory skills, preparing a scientific poster, and understanding what day-to-day research is like. Additionally, large majorities of >5 students reported they were somewhat or very likely to pursue an advanced graduate degree (MS or PhD) and continue to pursue working in a research lab during the rest of their undergraduate tenure. The participating students were asked to rate how much they learned as a result of their summer UofA REU experience. Learning lab techniques and how to prepare research posters were the two highest rated outcomes. The variation across the other outcomes may reflect the ways in which the students were engaged in their summer research labs.

Research Activities	No Gain	Small Gain	Moderate Gain	Large Gain	Very Large Gain
Lab techniques	0	1	1	0	5
Writing scientific reports or papers	0	1	2	2	2
Making oral presentations	0	1	3	2	1
Explaining my project to people outside my field	0	1	3	2	1
Preparing a scientific poster	0	1	1	0	5
Keeping a detailed lab notebook	0	2	3	1	1
Using statistics to analyze data	0	2	2	3	0
Understanding journal articles	1	0	3	1	2
Ability to work independently	1	1	1	1	3
Understanding what everyday research is like	0	1	1	1	4

BMES Presentation and Conference Attendance

The students were sent a one-question survey about their experiences at the fall BMES conference. Five (5) students responded to the survey. Networking with other researchers and presenting a poster were the predominate activities.

Conference Activities and Outcomes	Number of Students Responding
I did not attend BMES or any other conference last fall	0
This was my first professional conference	3
I attended workshops for skill development before the conference started	0
I presented a poster on my research	5
I gave a presentation at the conference	0
I networked with other undergraduate students doing biomedical research	5
I networked with graduate students doing biomedical research	3
I networked with university faculty and researchers	5
I looked for graduate school opportunities	4
I met graduate school representatives	4
I talked with vendors in the exhibit hall (e.g., publishers, software, graduate schools)	1
I learned about the wide variety of research in biomedical engineering	5
Listening to the presentations helped me focus my career in biomedical research	1

Conclusion

Overall, students attending the Biomedical Optics and Imaging REU at the University of Arkansas reported favorable experiences, gained significant specific laboratory and presentation skills in areas crucial to biomedical engineering, and were more likely to attend graduate school following the completion of this program.

Acknowledgements

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