

Supplemental Material

CBE—Life Sciences Education

Erickson *et al.*

Supplemental online materials for
“How do we do this at a distance?!” A descriptive study of remote undergraduate research programs during COVID-19

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REMOTE REU SITE PROFILE TEMPLATE

Scientific theme(s):

- Program name:
- Link to your REU site webpage if you have one:
- Link to the public abstract for your REU site from the NSF website (or other funding source if applicable)
- Briefly describe the discipline(s) or general scientific themes of REU site
- Please indicate an author of the profile:

Nature of the research:

- Briefly describe the nature of the research that *typically* occurs in this site (bench, field, computational, other) in non-COVID years (if applicable)
- Briefly describe the nature of the research that occurred this year (bench, field, computational, other) and the extent to which the nature of the research had to change due to COVID-19.
- Were any new mentors recruited to the REU site because of the COVID-19 transition? For instance, were any mentors recruited this year because they had computational projects that were suitable for undergraduates? If yes, please briefly explain.
- Did experienced REU mentors have to generate / design new projects or research tasks because of the COVID-19 transition? For instance, were any mentors expecting to do field or benchwork who then developed a new/different project to make it possible to involve an undergraduate at a distance? If yes, please briefly explain.

Program activities and expectations

- **Time commitments:**
 - About how many hours and/or days per week were students expected to work?
 - To what extent were time commitments flexible or set?
 - To what extent did the program set time commitments or let labs/mentors set time commitments?
 - Briefly explain whether time commitments were handled differently because of COVID-19.
- **Structure:**
 - Did mentors and/or or students work together differently than during previous summers because of the remote nature of the site? For instance, did students work in pairs or teams this year but not previously? Did mentors work collaboratively to mentor students this year but not previously? If yes, please describe.
 - Please describe a typical week in the program to give a sense of how the program operated on a day-to-day and week-to-week basis.
- **Programming:**
 - Please describe the program activities other than the research experience. Include brief descriptions of any formal (scheduled) aspects of the program, such as preparation to help students work remotely, training, professional development, workshops, panel

discussions, discussions of antiracism or social justice-related topics, social events, game nights, office hours, journal clubs, poster/talk presentations, etc.

- As much as possible, please indicate how **often** even type of event occurred (daily, weekly, monthly, once during the program), how **long** the event(s) typically lasted, and the context for the event / whether it was synchronous or asynchronous (e.g., synchronous zoom meeting). For example: “The program ended with a two-hour poster synchronous symposium on zoom during which each student presented their work for 10 minutes followed by 5-minutes of Q&A.”
- To the extent you know, did any informal (unscheduled or unstructured) activities occur related to the program? If so, please describe.
- Please describe any program activities intended for **mentors**, such as professional development on mentoring, discussions to plan remote-friendly projects, preparing mentors to work with students remotely, etc. Again, please include details about frequency and duration if possible.
- **If applicable**, please describe any **new elements** of the program that you will continue to do in the future, including a **brief explanation of your reasoning**.

Please provide any other information that would be helpful for understanding how your REU site was designed and implemented, especially any differences or unique elements due to COVID-19.

Biological Interactions Summer Research Program

PIs: Janet Branchaw & Amber Smith; General scientific theme: Interactions of Genotype and the Environment

Website: <https://wiscience.wisc.edu/IBS-SRP> Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1659159

Programming

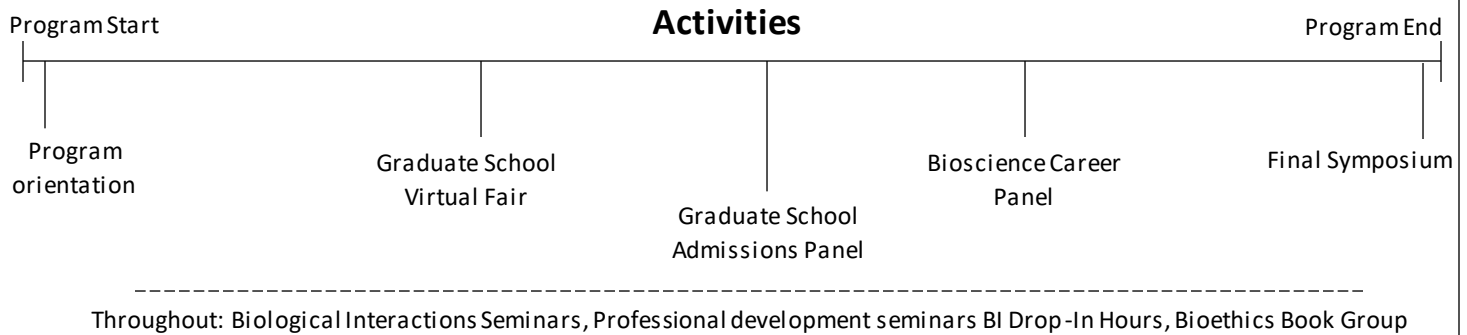
- The nature of research was computational.
- 12 students and 11 mentors
- 8 weeks for 21-40 hrs/week depending on level of engagement; students either engaged in part-time research or full-time research
- Synchronous and asynchronous components

Influence of Pandemic

- The nature of research is typically bench and field research, but these kinds of research could not occur due to the pandemic.
- New mentors were not recruited as a result of the pandemic; students were already placed with mentors when the program shifted to a virtual format.
- All mentors had to redesign their projects to focus more on computation and experimental design so students could participate remotely.
- Students did not work in groups as a result of the pandemic.

Mentors

- The mentoring structure mostly stayed the same as in previous years, but this year grad students and postdocs, "Badger Buddies," were also recruited to provide mentorship and support to students.



Activity Type	Description
Starting event	Program orientation: Much of the orientation was devoted to a series of community building exercises to help students get to know one another and practice using Zoom features to facilitate online engagement. The orientation also included information about program logistics, expectations, and how to access materials needed for the program. The session ended with a reflection on their readiness for research and a goals setting exercise.
Professional development	Weekly professional development seminars were held for students to gain skills and knowledge in navigating the research environment, develop effective mentor-mentee relationships, and explore psychosocial constructs (e.g., self-efficacy, imposter syndrome, growth mindset, stereotype threat), research careers, ethics, and diversity in STEM and science communication. Graduate School Virtual Fair: This event was an all-day fair in which students could come and go freely. Students had the opportunity to learn about graduate programs and connect with program staff to ask questions. Graduate School Admissions Panel: Graduate program directors and coordinators discussed the application process and qualities that make for a strong candidate. Students had the opportunity to ask questions. This event was one hour in duration.
Scientific	Bioethics Book Group: Students and Badger Buddies were invited to read <i>The Immortal Life of Henrietta Lacks</i> by Rebecca Skloot and discuss in a weekly book group. This summer a group of 8 students and Badger Buddies participated. This was an optional activity.
Research	Biological Interactions Seminars: Students met weekly to engage in activities and discussions about research and science careers. These sessions provided the opportunity to hone students' skills of observation, critical thinking, and creativity as they worked in small groups with a faculty expert to explore a phenotype.
Other	BI Drop-In Hours: Each week students were invited to join their peers and Badger Buddy mentors to ask questions about the program or questions about grad school, research, or career paths. Each week had a topic for discussion, but students could ask any question at any time. Social activities rounded out the hour if there was time after the discussion.
Ending event	Final Symposium: Students created graphical abstracts about their projects and gave a 5-minute presentation about their work over the summer and answered questions for 5 mins. Mentors and peers attended and asked questions.

Bruins-in-Genomics(BIG) Summer Undergraduate Research Program

PIs: Alexander Hoffmann & Hilary Coller; General scientific theme: Bioinformatics & Computational Biology

Website: <https://qcb.ucla.edu/big-summer/>

Programming

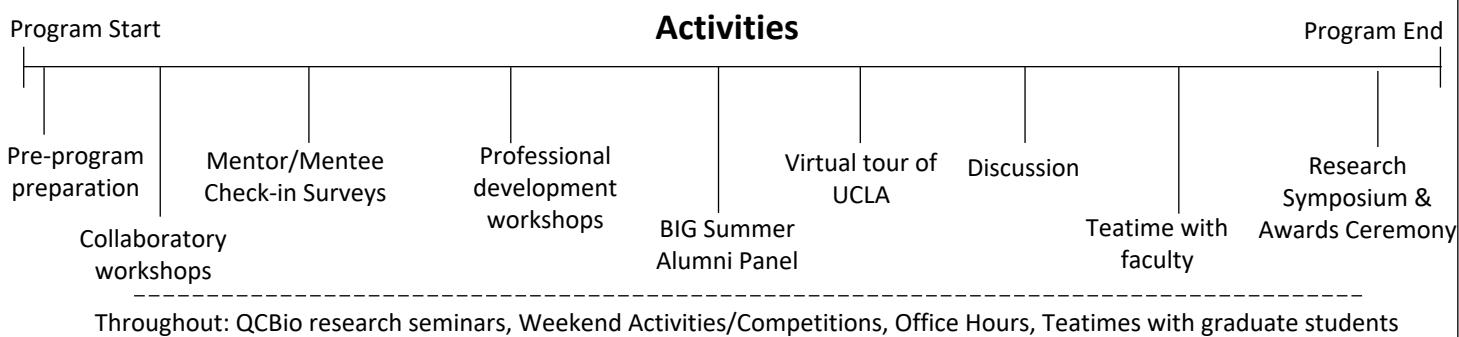
- The nature of research was computational.
- 12 students and 15 mentors
- 8 weeks for 40 hrs/week
- Synchronous and asynchronous components

Mentors

- There was one assigned day-to-day mentor who was directly responsible for their students, but often several lab members participated in mentoring. This was not as a result of the pandemic.

Influence of Pandemic

- Nature of research did not differ substantially from previous years; it was still computational.
- New mentors were recruited to the site because some faculty were less enthusiastic about mentoring additional students given their other responsibilities at work or at home during the pandemic.
- Experienced mentors did not have to redesign their projects, but they had to think more carefully, and re-work their mentoring styles and mechanisms to engage and guide students.
- Most, but not all, students worked in pairs this year.



Activity Type	Description
Starting event	Pre-program preparation: A list of resources (videos) was sent to students prior to the start of the program to help familiarize students with relevant skills/concepts.
Professional development	Professional development workshops: These workshops were optional and held on weeks 4-8. They were 30 minutes to an hour in duration and were held via Zoom. Students attended relevant workshops on topics ranging from How to Create an Online Presence to How to Prepare a Poster Presentation. BIG Summer Alumni Panel: This optional one-hour event was held synchronously via Zoom. Students participated in a panel discussion with BIG SUMMER Alumni from 2015-2019. Topics of discussion included mental health in graduate school, how to select and apply to graduate school programs, and industry vs. academia. Discussion: This event was an optional synchronous talk with HBCU African-American, female students (led by Tracy Johnson) via Zoom. Bioinformatics teatime with graduate students: These were biweekly optional events in which students could meet with graduate students via Zoom.
Scientific	Weekend Activities/Competitions: Students participated in a combination of team-based and individual activities. The one-time BIG Summer Hackathon was a 2-day team-based, synchronous activity that took place via Zoom, while the T-shirt Design and Scientific Prose competitions were individual, one-time, asynchronous activities that were recorded and shared via the BIG SUMMER Slack Channel and email. These were optional.
Research	Collaboratory workshops: These mandatory workshops were held on weeks 1-3, were an hour in duration, and were held daily via Zoom. Students attended scheduled workshops relevant to their research projects assigned by their mentors. QCBio research seminars: These 30-minute seminars were held every week via Zoom. Students were exposed to cutting edge research presented by UCLA postdocs and faculty.
Other	Mentor/Mentee Check-in Surveys: These were given asynchronously during weeks 1, 2, and 4. Surveys were used as a means of checking in with both mentors and mentees and identifying any pressing issues throughout the program via email. Virtual Tour of UCLA: This was a one-hour, optional asynchronous event. Office hours: Optional daily, open office hours, synchronous via Zoom. Students scheduled appointments with the program manager to discuss progress in labs, projects, and admissions. Teatime with Faculty: During week 8, students had the opportunity to meet with select faculty to ask questions and receive guidance on admissions for UCLA graduate school programs.
Ending event	Research Symposium & Awards Ceremony: The program ended with a two-hour, synchronous theme-based Research Symposium followed by a 45-minute Awards Ceremony via Zoom. Students were allotted 5 minutes to present their research projects followed by a 10-minute group discussion and Q&A. Students and faculty were recognized for mentorship and research excellence at the Awards Ceremony.

Cary Institute of Ecosystem Studies REU

PI: Alan Berkowitz and Kevin Burgio; General scientific theme: Translational Ecology

Website: <https://www.caryinstitute.org/eco-inquiry/reu-program> Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1559769

Programming

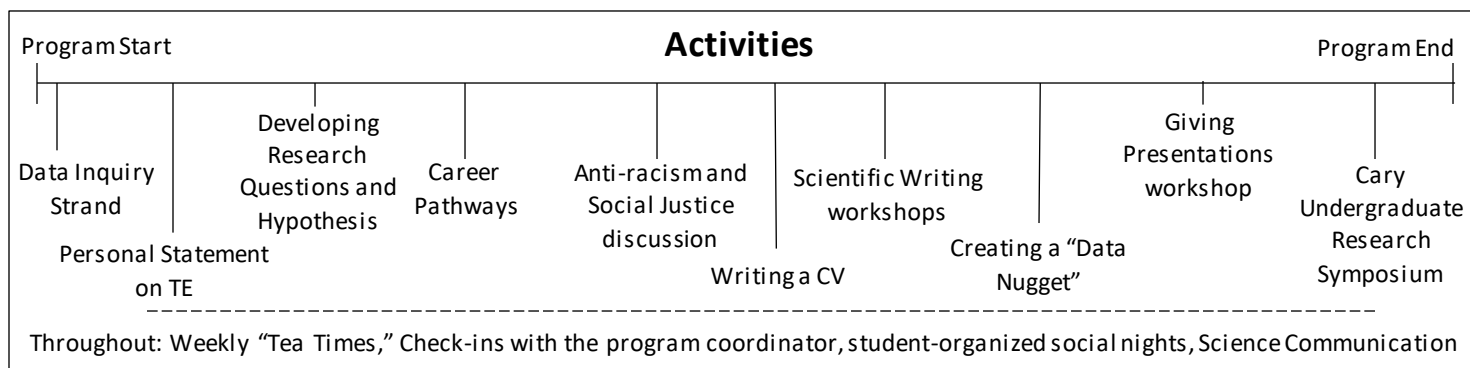
- Nature of research was translational ecology.
- 12 students and 20 mentors
- 11 weeks for 35-40 hrs/week
- Synchronous and asynchronous components

Mentors

- Several projects already had a team of mentors (either several senior scientists, or a senior scientist and post doc or grad student) which allowed for increased student support.

Influence of Pandemic

- The nature of research was shifted to focus more on computation rather than field work and data collection.
- The same pool of mentors was maintained despite drastic changes to the program.
- Most of the mentors involved had to alter the subjects of student projects to accommodate the altered nature of research.
- There were four research teams comprised of 3 REU students and a Cary post doc to provide additional peer-to-peer support and scientist-student mentoring.



Activity Type	Description
Starting event	Students began interacting with their mentors ahead of time, reading papers, and looking at data. Students and mentors also completed a Mentor/Mentee contract during this time.
Professional development	Data Inquiry strand: Data carpentry online training module, GitHub Carpentry online training module, 6 one-hour synchronous R workshops, 2 one-hour synchronous Metadata workshops, Stats support small groups and Slack channel. Career Pathways: 1 one-hour synchronous workshop led by one of Cary's scientists and 2 postdocs. TE in Action Panels: 4 one-hour synchronous panel discussions on the topics of Science Communication, Ecology in the private sector, Environmental advocacy, and Ecology in NGOs led by 2-3 people who work in various non-academic sectors. Students responded to reflective prompts before and after each panel. Personal Statement on Translational Ecology: Students completed a statement presenting their perspectives and expertise in Translational Ecology suitable for use in job and graduate school applications. Writing a CV and contacting potential grad school advisors: A one-hour synchronous workshop led by the REU program coordinator.
Scientific	Science communication: 5 one-hour synchronous workshops focusing on the fundamentals of science communication led by Cary Institute's communications staff. Creating a "Data Nugget": 2 one-hour synchronous workshops were led by Cary's education staff, helping students understand basic strategies for ecology education, with a focus to developing a draft Data Nugget.
Research	Conducting literature searches: A total of 2 one-hour synchronous workshops led by Cary Institute's librarian/data manager. Using citation managers: A one-hour synchronous workshop led by Cary Institute's librarian/data manager. Developing research questions and hypotheses: A one-hour synchronous workshop led by the REU program's director. Scientific writing: 4 one-hour synchronous workshops led by one of the REU program co-directors and the REU program coordinator. Giving presentations: A one-hour synchronous workshop led by the REU program coordinator.
Other	Weekly "Tea Times": 7 one-hour informal synchronous discussions with scientists from various fields within ecology to talk to the students about different aspects of being a scientist. Anti-racism and social justice discussion: A one-hour synchronous discussion led by the REU program coordinator.
Ending event	Cary Undergraduate Research Symposium: 7-minute presentations with 3 minutes for questions. Research paper: Students chose among options for a basic final report, a paper to be 'published' by Cary in its on-line Undergraduate Research Reports collection, or a paper to be submitted to a peer-reviewed journal.

Exploring 21st Century Careers in the Biological Sciences: A Comparative Regenerative Biology Approach

PI: Jane E. Disney; General scientific theme: Comparative Regenerative Biology and Aging

Website: <https://mdibl.org/education/undergraduate-opportunities/reu/>

Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1851962

Programming

- The nature of research was computational, related to regenerative biology and aging or COVID-19.
- 6 students and 5 mentors
- 10 weeks for 40 hrs/week
- Synchronous and asynchronous components

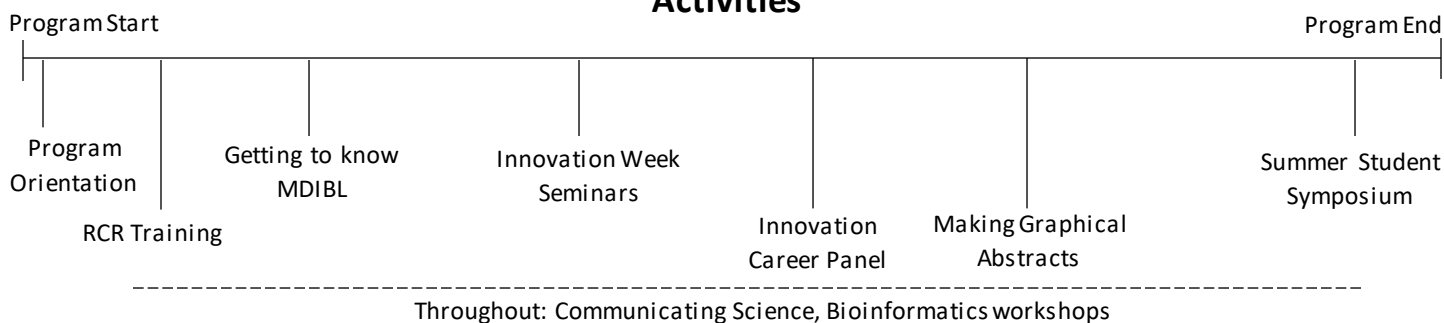
Mentors

- Mentors and/or lab group members met students 1:1 multiple times per week.
- Two faculty members co-mentored a pair of students; another faculty member transitioned a pair of students to Covid-19 projects when datasets became available.

Influence of Pandemic

- The nature of research typically includes benchwork components, and this year it was changed to be solely bioinformatics research.
- New mentors were not recruited as a result of the pandemic.
- All research projects were changed to accommodate the need for students to work remotely.
- Two students worked together on two separate bioinformatics projects as a result of the pandemic.
- The director of the Bioinformatics Core at MDIBL created a Bioinformatics Training Program to support students and mentors during this time.

Activities



Activity Type	Description
Starting event	Program orientation: Students were given a PowerPoint presentation by the president of the MDI Biological Laboratory on the history and current research of MDIBL. Representatives from the Finance, Education, Human Resources, and Development departments were present and reviewed campus processes and procedures with students. Students reviewed schedules of upcoming seminars, workshops, training opportunities, and other activities for the summer and had opportunities to ask questions.
Professional development	Communicating Science: All REU research fellows participated in a weekly course called Communicating Science. Students were introduced to best practices in quantitative communication, scientific writing, and in delivering formal scientific talks. Bioinformatics workshops: In a 2-part Bioinformatics introduction and follow-up weekly workshops, students gained an understanding of the importance of viewing computational and statistical analysis as an integral part of their experimental work. Aspects of this training included statistical assessment of projected experiments before data were collected. Innovation Career Panel: Students engaged in a discussion with a panel of innovative entrepreneurs. Each panelist introduced themselves, explained where they are today, and addressed the concept of innovation thinking and how they have applied it to their work.
Scientific	Innovation Week seminars: Students participated in 3 one-hour seminars, Innovation Thinking: An Introduction to Innovation Skills, Technology Transfer and Intellectual Property, and Case Studies from the Innovation Cohort at Maine Medical Center as a part of their Innovation Week activities.
Research	Responsible conduct of research (RCR) training: All students participated in a 2-hour RCR training given by the program's PI, Dr. Jane Disney. It included case studies for students to review and discuss. Students also participated in role playing scenarios in Zoom breakout rooms where they enacted events that might occur between students, mentors, and human resources.
Other	Getting to know MDI Biological Laboratory: Students viewed a "live" virtual tour of the campus and laboratory spaces and participated in a meet-the-faculty Zoom session, where each member of the research faculty introduced themselves to the students and described their research programs and invited questions from students.
Ending event	Summer Student Symposium: The culminating event of the program involved three days of sharing research. The first two days were asynchronous and were dedicated to students' Poster Sessions in which each student uploaded a biography, abstract, and poster. Participants could leave comments and questions for students to address. The last day was dedicated to students' oral presentations in the format of a Three-Minute Thesis.

Fungal Genomics and Computational Biology Summer Research Program

PIs: Jonathan Arnold; General scientific theme: Fungal Genomics and Computational Biology

Website: <https://www.genetics.uga.edu/fungal-genomics-and-computational-biology>

Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1946937

Programming

- The nature of research was genomics and computational biology.
- 13 students and 11 mentors
- 10 weeks for 40 hrs/week
- Synchronous and asynchronous components

Mentors

- There was one collaborative project on COVID-19 in which mentors worked together, but each REU participant had their own project within the larger project.

Influence of Pandemic

- Nature of research was shifted to focus solely on mathematical sciences and work that could be done on the computer.
- More computational biologists were recruited to the site to replace those mentors that put students on the bench.
- Some bench scientists designed new projects that could be done computationally.
- Some students did work collaboratively as a result of the pandemic; however, each REU participant had their own research project.

Program Start

Activities

Program End

Computer training

George Floyd Discussion

Responsible Conduct of Research Seminars

Final Symposium

Throughout: Weekly student-organized luncheons, research seminars, Zoom meeting with other REU partners

Activity Type	Description
Starting event	Computer training: REU participants participated in a computer training throughout the first week of the program.
Professional development	Bioethics/Responsible Conduct of Research Seminars: These seminars were held once a week by UGA. Topics of these seminars included: Bioethics of CRISPR, Best Lab Practices and Academic Freedom, Science Communication, Risk Communication, Use of Sex and Race Categories in Research, Mentoring, and Collaboration and Workplace Rights.
Scientific	Research Seminars: These seminars were held every Thursday and dealt with various topics including a COVID19 research seminar.
Research	Luncheon meetings with mentors: Students met with REU mentors every week on Tuesdays. Mentors met with REU participants 1 to 3 times per week via Zoom.
Other	Student Luncheon: Students self-organized weekly luncheons. Zoom meetings with other REU partners. Luncheon meetings with mentors: Students met with REU mentors every week on Tuesdays.
Ending event	Final Symposium: Students, gave a 10-minute presentation about their work over the summer, and answered questions for 5 mins. Mentors and peers attended and asked questions. These presentations were then uploaded to YouTube.

Genes & the Environment: Research Experiences for Undergraduates from Rural & Tribal Colleges at the University of North Dakota (UND)

PI: Van A. Doze; General scientific themes: Molecular & Cell Biology, Epigenetics, Gene Regulation, Computational and Systems Biology, & Neuroscience.

Website: <http://ndinbre.med.und.edu/NSF-REU/> Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1852459

Programming

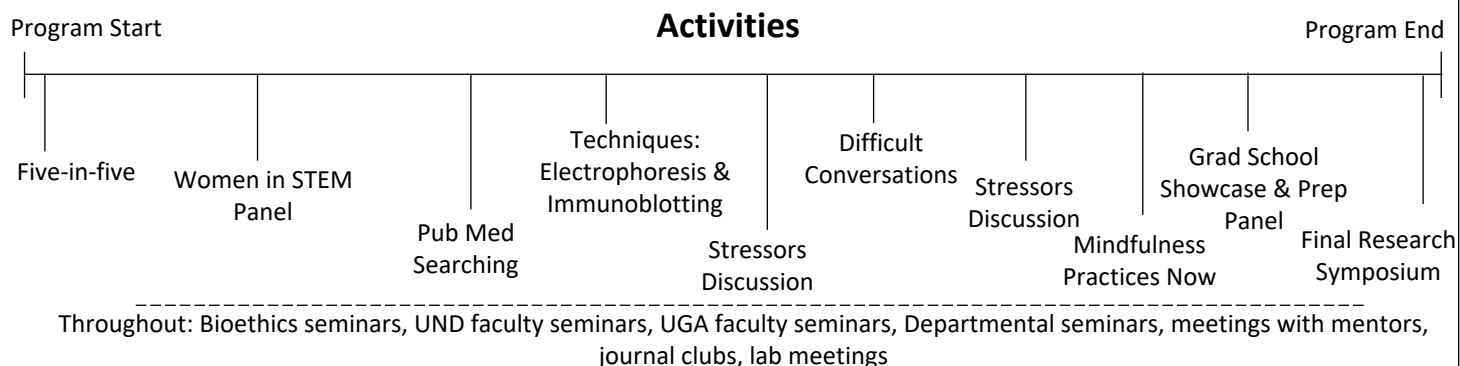
- The nature of research was computational and systems biology.
- 25 students and 11 mentors
- 10 weeks for 40 hrs/week
- Hybrid program with some (7) students participating in in-person activities and most (18) completely remote.

Mentors

- Mentors did not work in teams or collaborate more as a result of the remote format.

Influence of Pandemic

- Nature of research did not differ substantially from previous years.
- No new mentors were recruited as a result of the pandemic, although only 11 of the 20 original mentors decided to participate.
- Two mentors developed entirely new projects due to the remote format, and others had students work on aspects/tasks of the lab's research projects which could be done remotely (e.g., data analysis, genomics).
- Some labs that had less experienced students had students work in groups.



Activity Type	Description
Starting event	Five-in-five: Each student presented 5 slides about themselves as an introduction; several faculty/staff participated. This event continued for approximately 3 weeks with 1-2 meetings/week. It was held synchronously via Zoom and was 1-2 hours in duration.
Professional development	Bioethics/Responsible Conduct of Research Seminars: These seminars were held once a week by UGA. Topics of these seminars included: Bioethics of CRISPR, Best Lab Practices and Academic Freedom, Science Communication, Risk Communication, Use of Sex and Race Categories in Research, Mentoring, and Collaboration and Workplace Rights. Virtual Grad School Showcase and Grad School Prep Panel. NSF-GRFP Presentation Graduate Research Fellowships Program. Women in STEM – Making Smart Choices for Your Career Panel Discussion: This synchronous presentation was facilitated by 3 UND female science faculty members.
Scientific	UND faculty research seminars: These seminars were held synchronously once a week via Zoom and lasted 1-1.5 hours in duration. UGA faculty research seminars: These seminars were held synchronously once a week. They included individuals in a wide variety of research fields who shared their academic/career journeys, many of which were not traditional. Departmental seminars: UND graduate students gave seminars and/or defended their thesis. These seminars were optional, held synchronously via Zoom, and were one hour long.
Research	Pub Med Searching: This event was held synchronously via Zoom, was one-hour in duration, and was provided by UNDSMHS Librarian. Techniques: Electrophoresis and Immunoblotting: This presentation was held synchronously over Zoom and was given by a Biomedical Sciences faculty member.
Other	Meetings with mentors, journal clubs, lab meetings: These varied by lab. Stressors Discussion Sessions (COVID19 stress; racism; riots): Two Zoom sessions facilitated by UNDSMHS Assistant Director of Interprofessional Education. Difficult Conversations: One synchronous Zoom session facilitated by UNDSMHS Assistant Director of Interprofessional Education. Mindfulness Practices Now: One synchronous/Zoom session: An exploration of mindfulness practices, evidence-based benefits, and how you can begin to apply mindfulness to your life to manage your body's stress response.
Ending event	Final Research Symposium: The program concluded with an all-day synchronous symposium on Zoom. Each student presented (on PowerPoint) their work for 10 minutes with 5 additional minutes for questions. There were 3 groups of 2-3 students; all others were individual presentations.

iCompBio at the University of Tennessee at Chattanooga

PI's: Hong Qin & Soubantika Palchoudhury; General scientific theme: Computational and Quantitative Biology

Website: <https://www.utc.edu/faculty/hong-qin/icompbio.php>

Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1852042

Programming

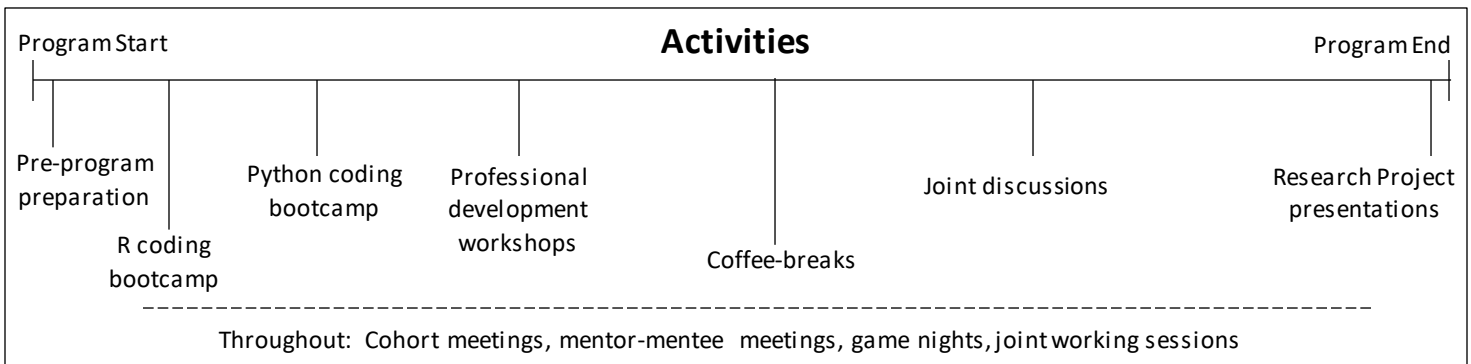
- The nature of research was computational and quantitative biology.
- 11 weeks for 40 hrs/week
- 12 students and 12 mentors
- Synchronous and asynchronous components

Mentors

- Mentors typically met with students two to three times during the week.
- PI Qin typically held joint meetings to ensure all participants were making progress on their research.

Influence of Pandemic

- Nature of research did not differ substantially compared to previous years.
- The iCompBio lab typically was designed for 10 undergraduates, however, this year that number was increased to 12 since research was virtual.
- Several faculty members joined the research team due to cancellations of other REU programs across campus.
- Approximately half the mentors proposed new research projects due to the pandemic.
- Each student had their own individual research project and mentor that they were assigned.



Activity Type	Description
Starting event	Pre-program preparation: This served as orientation and introduction to the program for student. Participants completed the CITI Responsible Conduct of Research program as well.
Professional development	The program hosted a formal presentation training workshop where they discussed the best practices of research presentations, followed by a working session on presentations in which students competed amongst one another to present a small presentation. Other students would then provide critical feedback for ways to improve. Students met with mentors on a frequent basis to discuss research. Additionally, all students attended an NSF GRFP webinar .
Scientific	Collaborative online documents were used to share reading notes and research progress with mentors and PIs. R coding bootcamp: This was a week-long program in which students went over basic data frame and computational programming skills such as retrieving and analyzing data. Python coding bootcamp: This was an intensive two-day programming bootcamp that focused on data analysis and data visualization.
Research	Weekly group meetings: Students discussed research progress and plans for the week. Joint working sessions: Students discussed their projects in groups to inform and receive advice from others on their individual projects. Open virtual office hours – “coffee breaks”: Students were welcome to join a zoom session to talk about research and ask questions with PI Qin.
Other	Two virtual game nights were hosted and planned informally by students within the program as well as with students outside of the REU program. Faculty were also invited to take part in these activities.
Ending event	Research Project Presentations: During the last two days of the ten-week program, all students gave 25-minute presentations on their research project and then had 5 minutes for Q&A. Family, friends, and professors from other universities were also invited to watch student presentations.

Integrative Biology and Ecology of Marine Organisms

PIs: Adam Summers & Stacy Farina; General scientific theme: Marine Biology, Ecology, Development, Physiology, and Biomechanics

Website: <https://fhl.uw.edu/research/summer-research-internships/>

Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1852096

Programming

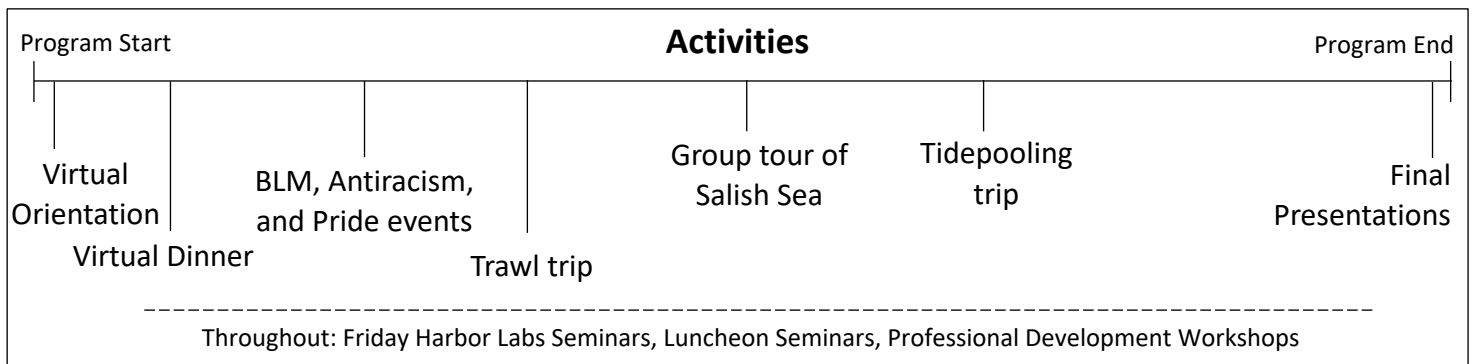
- The nature of research was lab and field experience.
- 11 students and 11 mentors
- 8 weeks for 30-40 hrs/week
- Hybrid in-person and remote components

Mentors

- There was one situation where an on-site mentor supplemented the mentoring of an off-site mentor.

Influence of Pandemic

- Nature of research did not differ substantially from previous years.
- No new mentors were recruited to the site as a result of the pandemic.
- Some mentors switched to more computationally intensive projects because the lab work was not possible.
- Students did not work in pairs or teams as a result of the pandemic.



Activity Type	Description
Starting event	Virtual Orientation: Students traveled to the site two weeks early to quarantine. During these two weeks, students met outside and participated in various team-building activities. Additionally, students and mentors introduced themselves, and mentors gave short introductions about what they do at the site. Virtual Dinner: Everyone who was involved with the REU site in some manner participated in a virtual dinner event over Zoom.
Professional development	Professional Development Workshops: Students participated in weekly professional development workshops, which included a graduate student panel, a grant workshop, a mock interview workshop, a writing workshop, an experimental design and statistics workshop, a literature review workshop, a bioethics workshop, and RCR training.
Scientific	Group tour of the Salish Sea: Students engaged in a group tour of the Salish Sea which was meant to give students a general appreciation for the wildlife they were studying. Trawl Trip: The REU participants were taken out on a fishing trawler. Students learned how to deploy trawl gear, catch fish, and sort the fish. Tidepooling Trip: Students ventured to nearby tide pools to examine the fauna living within them.
Research	Friday Harbor Labs Seminar Series: Professors, graduate students, and/or post-docs that were doing research or had previously done research at Friday Harbor labs delivered presentations to students virtually. These were held weekly. REU Luncheon Seminars: Professors and researchers delivered 40–50-minute presentations to students, and students were encouraged to ask questions and participate in an open, informal discussion.
Other	BLM, Antiracism, and Pride Events: Students made posters and banners in honor of the Black Lives Matter movement and Pride month. Students were encouraged to reflect on current events and have conversations with one another about what was going on at the time. Outdoor game activities: Students participated in 2 game nights during the program.
Ending event	Final Presentations: At the beginning of the final week of the program, students delivered their presentations via Zoom. The whole island was invited to the symposium. Students were given feedback to incorporate into their final papers, which were due at the end of the final week.

The Interdisciplinary and Quantitative Biology Research Experience for Undergraduates (IQ BIO REU) at the University of Puerto Rico

PI: Juan Ramirez Lugo & Patricia Ordoñez; General scientific theme: Bioinformatics, Genomics, Computational, and Quantitative Biology.

Website: <http://iqbioreu.uprrp.edu> Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1852259

Programming

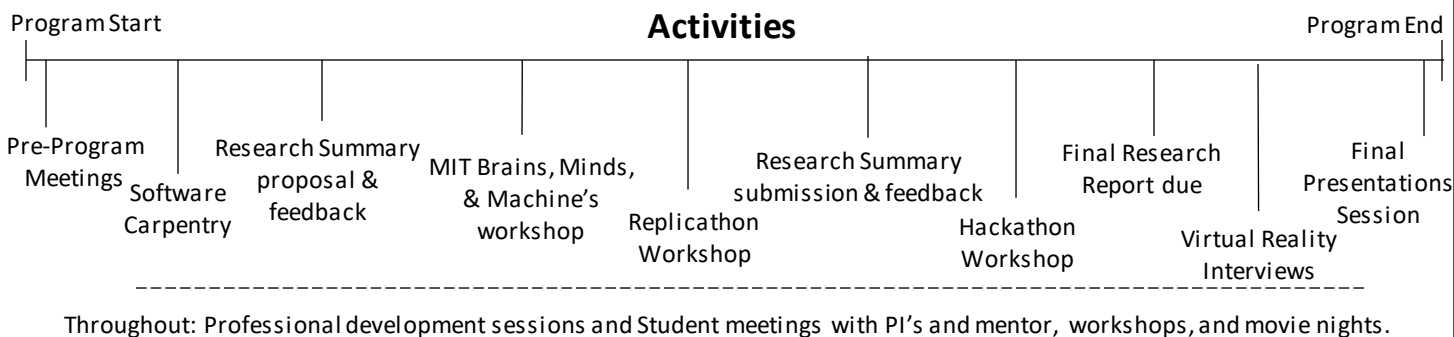
- The nature of research included quantitative and computational biology, gene expression analyses, bioinformatics, and land use dynamics in tropical ecosystems.
- 9 weeks for 37.5 hrs/week
- 12 student and 7 mentors
- Synchronous/Asynchronous

Mentors

- Participants were recommended to meet with the PIs and mentors at least once a week to discuss research progress. PIs required "Monday Check-Ins" with students to ensure mentors and students were communicating frequently.

Influence of Pandemic

- Nature of research changed to being strictly computational which differed in comparison to past years where computational work was combined with field and laboratory work as well.
- No new mentors were recruited to the site, and fewer mentors participated in the program compared to past years since not all projects were able to transition remotely.
- In previous years, students worked alone in labs. However, this year, students were paired together in lab groups to allow for collaboration and social bonding in the new virtual format, but each student had their own individual research project.



Activity Type	Description
Starting event	Pre-Program Meetings: Prior to the program beginning, researchers held two remote meetings with students to help layout expectations for the summer and respond to any potential questions or concerns. These meetings were also intended to help promote social engagement and cohesion amongst students.
Professional development	Professional Development Sessions: During the first 5 weeks of the program, 2-4 professional development sessions were held each week for approximately 1-1.5 hours. During the last 4 weeks of the program these sessions occurred only 1-2 times a week as student feedback indicated participants wanted more time to focus on research. Virtual Reality Interviews: At the end of the program, students used a virtual platform, Mozilla Hubs, to discuss their research with other students. This session lasted for about one hour, during which students had very brief one-on-one discussions about their research projects using virtual avatars.
Scientific	Software Carpentry: These workshops took place during the first 7 days of the program and students spent ~4 hours each day in workshops learning basic coding skills, statistical research skills, and programming. During these workshops students were placed into Zoom breakout rooms to allow for collaboration of ideas. Replication Workshop: This was a two-day workshop dedicated to data reproducibility using R studio. MIT Center for Brains, Minds and Machines Workshop: This was a two-day workshop focused on three core themes: computation, neuroscience, and cognition. Hackathon Workshop: Students would attempt to hack into their own projects through collaboration with peers and local mentors from all types of different backgrounds in hopes of improving or expanding upon their research.
Research	Research Summary Submission & Feedback: During both the 3 rd and 6 th week of the program, students submitted a research summary and received feedback. Students were expected to use feedback to then make improvements that would be incorporated into their final report.
Other	Students participated in the #ShutdownSTEM movement taking place across the country. During this time students discussed implicit bias, and this was followed by a movie addressing themes of social justice. Movie Nights: Each week following the groups participation in the #ShutdownSTEM movement, the group decided to have weekly movie nights which consisted of films that touched on topics of racial injustice and race relations.
Ending event	Final Presentations session: The program ended by hosting a day-long final presentations session. During these presentations, students gave 10-minute presentations and had 3 minutes for Q&A.

RAPID: Undergraduate Research in Modeling and Computation for Discovery of Molecular Probes for SARS-CoV-2 Proteins

PI's: Mary Jo Ondrechen, Steven A. Lopez, and Mona Minkara; General scientific theme: Biochemistry, Computational Biology, Computational Chemistry

Website: <http://nuvreu.appspot.com/>

Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=2031778&HistoricalAwards=false

Research supported by NSF CHE-2030180

Programming

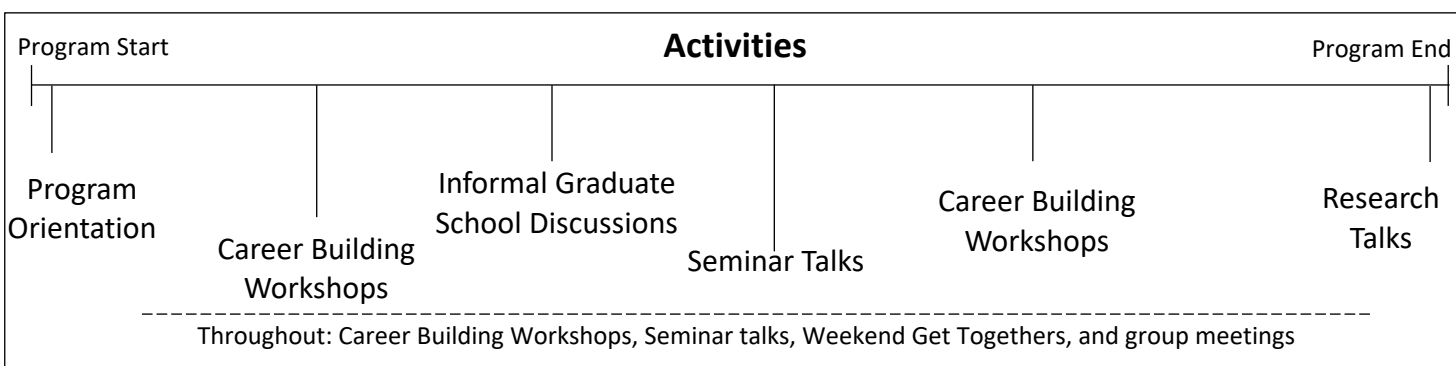
- The nature of research was computational.
- 8 students and 3 mentors
- 10 weeks for 35 hrs/week
- Synchronous and asynchronous components

Mentors

- Mentors did not collaborate with one another or work in teams as a result of the pandemic.

Influence of Pandemic

- This was a one-year project designed specifically for the pandemic and funded under the RAPID mechanism.
- All three mentors joined the project because of the needs that arose from the constraints of the pandemic.
- The projects were designed specifically to be done remotely, but this does not represent a significant change in the operations of the three PIs.
- Students did not work in teams as a result of the pandemic.



Activity Type	Description
Starting event	Program Orientation: The program held an introductory orientation session virtually in the form of a video conference that consisted of both students and mentors.
Professional development	Career building workshops: All students participated in various career building workshops; one such example was a presentation by Dr. Ondrechen on fellowship applications. Informal Graduate school discussions: Mentors held informal discussions on graduate school and networking for participating REU students.
Scientific	Seminar talks: PI and mentor presentations on various topics related to their research such as background on the SARS-CoV-2 targets, designing inhibitors and binders that are light activated, as well as topics related to DEI. Students additionally gave presentations on their own work or a relevant literature presentation.
Research	Computationally driven structure-based ligand design: Students took different protein targets of SARS-CoV-2 and learned how to dock libraries of compounds into these targets and to interpret the results. This was followed by short reports for researchers, with details about the findings of the best compound. In some cases, compound predictions were sent to experimentalists for synthesis and laboratory testing. Students analyzed several million different compounds against SARS-CoV-2 targets. The different groups learned about various approaches to the analysis of protein targets, including molecular dynamics simulations and quantum mechanical modeling of SARS-CoV-2 targets and the predicted ligands.
Other	Weekend Get Together: Students would gather virtually and organize fun activities and games to promote a sense of social cohesion amongst the group. This was organized by students.
Ending event	Research Talks: Students presented a talk on their research projects and findings at the end of the summer with other REU students and faculty.

Research Experiences for Undergraduates in Genetic and Biochemical Mechanisms of Prokaryotic and Eukaryotic Organisms

PI: Fern Tsien & Allison Augustus-Wallace; General scientific theme: Genetics & Biochemistry

Website: <https://www.medschool.lsuhsu.edu/genetics/reu.aspx>

Abstract: https://nsf.gov/awardsearch/showAward?AWD_ID=1659752&HistoricalAwards

Programming

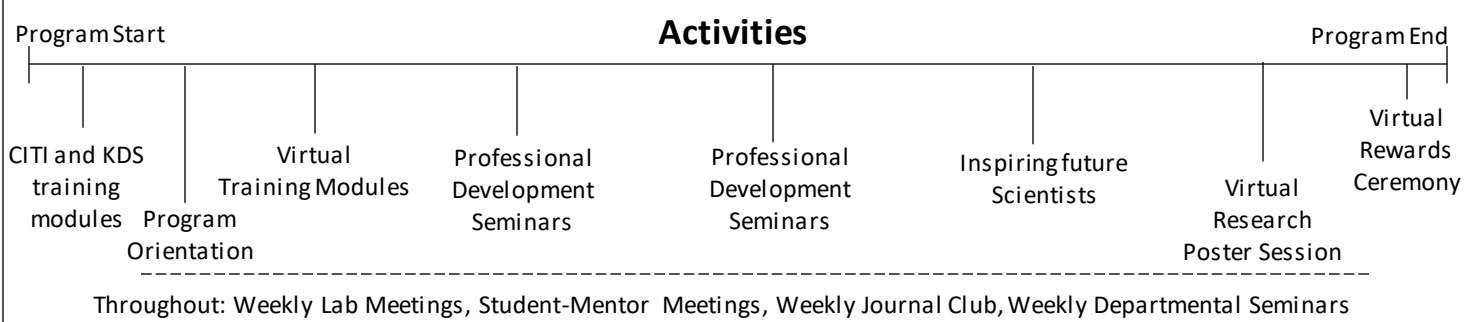
- The nature of research was bioinformatics, protein modeling, and data analytics.
- 25 students and 18 mentors
- 9 weeks for 5 days a week; no specified number of hours
- Synchronous and asynchronous components

Mentors

- Experienced mentors did have to adapt their projects to a virtual model; some mentors had benchwork and animal research, which they then sent their data to the students to discuss and analyze together.
- Students and mentors met at least 3 times during the week to discuss research projects.
- Diversity and Inclusion modules were required for all mentors prior to the program beginning.

Influence of Pandemic

- Nature of research changed in that it was genetic and biochemical wet-lab and/or computational research using in vivo and in vitro model organisms in previous years; however, it was predominately computational this iteration.
- No new mentors were recruited as a result of the pandemic.
- Students were partnered with alumni from other summer programs in the institution working with the same mentor and/or graduate students/post-docs.



Activity Type	Description
Starting event	Program Orientation: This served as an introduction for students and faculty. This meeting aimed to facilitate and build the summer programs sense of community to provide more open and welcoming communication amongst students and mentors. During the program they additionally covered ground rules and expectations regarding topics such as Zoom etiquette. All students were additionally required to sign a code of conduct.
Professional development	Weekly Professional Development seminars: Each week the program hosted professional development seminars with other summer programs for approximately an hour and a half. These included how to conduct a literature search and review, scientific communication skills (presentation and manuscript writing), working as a team, time management, communicating science to non-scientists, interviewing for graduate school, professional behavior training, resume and CV writing, and career education.
Scientific	Virtual Training Modules: Prior to the program beginning all students were required to complete CITI and KDS compliance training modules which provide peer-reviewed, web-based educational courses in research practices, ethics, responsible conduct of research, and professional conduct. Additional virtual training covered topics on safety and how to maintain a lab notebook. Software and IT support: REU interns received IT support and had access to all necessary software to facilitate their research.
Research	Mentor meetings: Students had zoom meetings a minimum of 3 times per week with their mentors which typically lasted around two hours. During this time, mentors would discuss research projects, provide fieldwork or computational data if applicable, and answer any questions/concerns students might be having. Weekly Lab Meetings: These meetings typically took place once a week for about an hour; the entire lab would meet and discuss ongoing research and other relevant topics.
Other	Inspiring future scientists: Students virtually presented their projects to partnering New Orleans area middle and high school science classes to promote STEM careers while serving as role models to younger generations of potential scientists.
Ending event	Virtual Poster Session: Each student made a research poster about their respective work and submitted a 5-to-10-minute prerecorded Zoom PowerPoint presentation explaining their research, along with an abstract and headshot. A Virtual Awards Ceremony: This was held via Zoom, and abstracts, posters, and Zoom recordings were displayed in the REU Poster Session website.

Research Experience for Undergraduates in Molecular Genetics and Cell Biology

PI: Aaron Turkewitz; Scientific theme: Molecular Genetics and Cell Biology; Program Directors: Jean Greenberg, Edwin Ferguson
 Website: <https://mgcb.uchicago.edu/education/reu> Abstract: https://nsf.gov/awardsearch/showAward?AWD_ID=1659490

Programming

- Nature of research was computational with mathematical modeling.
- 3 students and 2 mentors
- 10 weeks for 40 hrs/week
- Synchronous and asynchronous components

Mentors

- One faculty member mentored two students simultaneously, but this was not as a result of the pandemic.
- Near-peer graduate students monitored progress and fielded questions.

Influence of Pandemic

- Nature of research differed substantially from previous years. It is normally bench-work based, with an emphasis in cellular and molecular biology approaches.
- One new mentor was recruited to the REU site this year because they had computational projects available that were suitable for undergraduates.
- An additional faculty member was recruited to give advice on computational modeling.
- Students were allowed more flexibility in scheduling their workdays than in previous years.
- Near-peers in the PhD program, some of whom were previous REUs, were liaisons between the REUs and the program leadership.



Activity Type	Description
Starting event	Program orientation: This event was held at the beginning of the program as a way introduce students to each other and program leadership.
Professional development	Ethics workshops: These events were held once a week throughout the first five weeks of the program. NSF GRFP Webinar: This event was held once during the program and included a Q&A session. Professor presentations: MGCB assistant professors came to speak to students twice throughout the program. Informal discussion: Students were given the opportunity to have an informal discussion with a scientist from the University of Chicago. Discussion of application process for graduate school: An MGCB professor hosted a discussion that went over the process of applying to graduate school once during the program. Workshop on how to give a talk and how to listen to a talk: Program leadership gave verbal discussion and provided documents to the students with guidelines.
Scientific	Student presentations: The first was an introduction to each project and required students to complete a one-page write-up. The second was a presentation on students' mid-program progress, and the third was the students' ending event.
Research	Journal club: This event was held once at the beginning of the program. Research Talks: These presentations were given by professors, and two former REU student (a PhD student and a recent PhD recipient), throughout the program. Each research talk was preceded by a session with program leadership to introduce the topic and discuss a paper from the speaker.
Other	Optional drop-ins with program leadership: Program leadership held weekly optional meetings for students to join if they wanted. Social nights: Near-peers organized two game nights for the REUs.
Ending event	REU Symposium and Final Paper: This was the final presentation students gave as a part of their participation in the program. Leadership organized a follow-up meeting several weeks after program completion to discuss the program and student plans postgraduation.

REU Site at The Morton Arboretum: Integrative Tree Science in the Anthropocene

PI: Chuck Cannon & Silvia Alvarez-Clare; General scientific themes: Community Ecology, Conservation & Restoration Biology, Evolution, Plant Biology, Systematics; Website: <http://www.mortonarb.org/reu>

Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1851961&HistoricalAwards=false

Programming

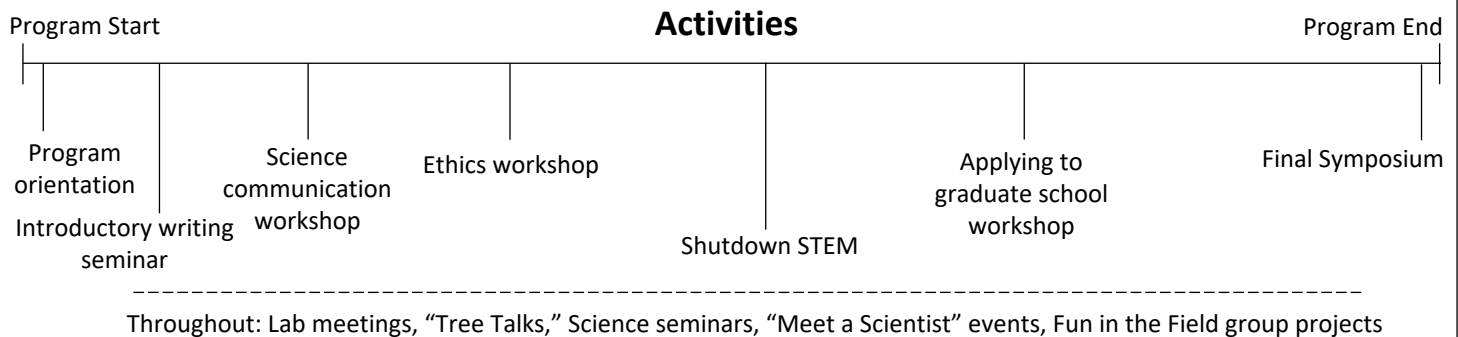
- The nature of research centered around the following main themes: impacts of global change on tree ecology, ecosystem function, tree evolution, conservation, tree growth, management, and function in the built environment and emerging technologies in tree science.
- 8 students and 13 mentors
- 10 weeks for 37.5 hrs/week
- Synchronous and asynchronous components

Mentors

- All students had at least two mentors.
- In most cases, an MS-level technician acted as a co-mentor for students alongside PIs at the Arboretum.

Influence of Pandemic

- The research themes remained the same as in previous years.
- Each mentor had to modify their project or create a new one so that students could conduct their research virtually.
- New mentors were not recruited as a result of the pandemic.
- All students worked alone (with the tech as their peer mentor) except for one group of students who worked together on separate datasets concerning the same species.



Activity Type	Description
Starting event	Program orientation: Students were welcomed to the program, given an introductory writing seminar, and met their mentors.
Professional development	"Meet a Scientist" events: The program held weekly events in which guest speakers from different tree-related career paths and jobs shared their experiences with students. Science communication workshop: A two-hour workshop held once during the program. Ethics workshop: A one-hour workshop held once during the program. Applying to graduate school workshop: A one-hour workshop held once during the program.
Scientific	Science seminars: A weekly two-hour writing class with breakout room activities and assignments due each week.
Research	Lab meetings: Each lab had a weekly lab meeting where the REU participated. "Tree talks": Weekly one-hour events that highlighted ongoing research efforts at the Morton Arboretum.
Other	Fun in the Field projects: Two-hour projects that consisted of tree-science projects that students completed individually outside and reported back as a group at a weekly virtual meeting. Check-ins with program coordinator: Weekly group meetings to cover logistics and to discuss challenges and successes. These were meant to serve as opportunities for emotional support as well. Shutdown STEM: A call for STEM and academic professionals to stop their usual work and spend a day learning about anti-racism and its role in science, as well as taking actions to support the Black community in STEM.
Ending event	Final Symposium: Symposium Keynote speakers were early-career scientists of color, including founder of Black Botanists Week who provided presentations and engagement discussions with students. Students had 12 minutes to present work and 3 minutes for questions.

REU Site: Global Change Ecology at the Smithsonian Environmental Research Center

PI: Alison Cawood; General scientific theme: Global Change Ecology

Website: <https://serc.si.edu/internships> Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1659668

Programming

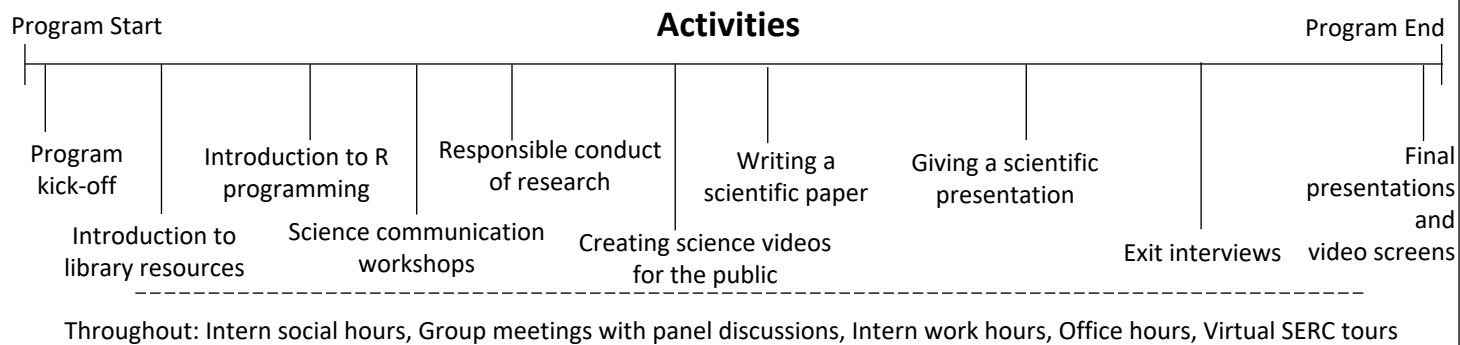
- The nature of research was mainly analysis of existing data, but there were two cases in which students were engaged in new data collection.
- 11 students and 13 mentors
- 9-12 weeks for 30-40 hrs/week
- Synchronous and asynchronous components

Mentors

- Mentors did not work collaboratively to mentor the same student, but in the cases in which students worked in teams, all interns and mentors met together.

Influence of Pandemic

- The nature of research is typically heavily fieldwork-based, and nearly all projects include laboratory elements, but most projects this year were based on data analysis.
- No new mentors were recruited as a result of the pandemic.
- All labs were able to either adapt the original project idea to focus on existing data or developed new projects that fit within the scope of the lab, the intern's interests, and could be done remotely.
- Some students did work in teams, but not all students within a team had the same mentor.



Activity Type	Description
Starting event	Program kick-off: Students were welcomed and given an introduction to SERC by the site director. Interns and mentors gave brief introductions as well. This event was 90 minutes in duration.
Professional development	Introduction to R programming: This training was a 4-part series of 3-hour workshops. Science communication workshop: This training was a 4-part series of 1-hour workshops. Making a poster training. Group meetings with panel discussions: Weekly full group meetings were facilitated by the REU site PI and included share outs from interns and a 90-minute panel discussion. Panels included SERC staff as well as outside speakers. Panel topics included Diversity and Inclusion in STEM, non-academic uses for environmental data, STEM careers, tips for grad school, and a panel of former SERC interns who had been co-authors on papers related to their REU work or who had presented their REU work at conferences.
Scientific	Introduction to library resources training. Giving a scientific presentation training. Creating science videos for the public training. Writing a scientific paper training.
Research	Responsible conduct of research training: This was a discussion-based training session. Collaborative intern work hours: These were held weekly.
Other	Intern social hours: These weekly events were facilitated by the intern coordinator and included games and activities. Virtual tours of Smithsonian sites. Video assistance and presentation assistance office hours: These started in week 8 of the program.
Ending event	Final presentations and video screens: Each intern gave a 12-minute presentation for a scientific audience and showed a 3-minute video for a public audience based on their internship work. Exit interviews: Students had interviews with the site PI during the last week of the internship. These were about 30 minutes in duration.

Rocky Mountain Biological Laboratory: Research Training in Place-Based Field Research

PI: Jennifer Reithel and Rosemary Smith; General scientific theme: Ecology and Evolutionary Biology

Website: <https://www.rmbll.org/students/undergraduates-beyond/summer-education-programreu/>

Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1755522

Programming

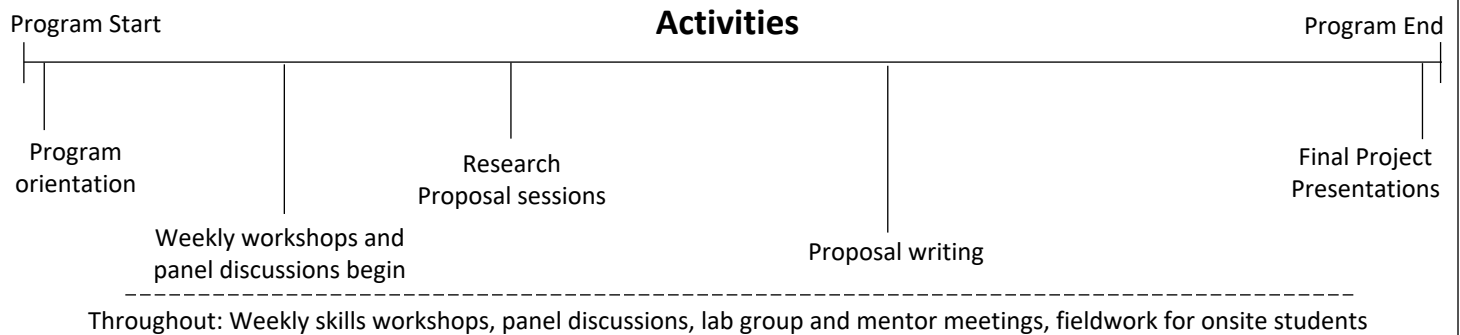
- Nature of research was Ecology and Evolutionary Biology.
- 39 students and 16 mentors
- 10 weeks for 40 hrs/week (not enforced)
- Hybrid program with most students participating in in-person activities and 6 students entirely remote

Mentors

- Mentors regularly collaborated, and several of the group projects depended heavily on onsite mentor and offsite mentor collaboration.
- Mentors discussed all initial project ideas with program coordinators and met with their lab teams at least once a week.

Influence of Pandemic

- Due to the pandemic, mentors had to adapt new projects or repurpose existing projects. They developed a hybrid on-site and remote model that allowed both students and mentors to decide how they would participate.
- Rather than have every student conduct an individual field research project as was typical in years past, some students worked on group research projects in which onsite students collected data and remote students then processed and analyzed this data.
- The lab applied for and received ROA funding which allowed for two local scientists to be recruited to serve as in-person mentors for scientists unable to be onsite for field research.



Activity Type	Description
Starting event	Program Orientation: The first three days of the program included an online orientation program for all 39 students.
Professional development	Mentor Development: Mentors were provided with materials from the “Entering Mentoring” program, including links to mentoring skill development. Additionally, graduate students organized a mentoring network for the program’s participants. Weekly Panel Discussions: At least 8 panel discussions were given throughout the summer to all program participants on topics including diversity issues, Title IX, animals in research, science communication, and applying to graduate school.
Scientific	Weekly Workshops: These workshops focused on topics such as statistics, graphing, GIS, and metadata submission.
Research	Proposal sessions: Research proposals took place in sessions throughout the third week of the program for approximately 1-1.5 hours, where each student or student group would present for approximately 10-15 minutes. Approximately half the students worked in groups on research projects, where on-site group members would collect field data and remote students would then organize and analyze the data. Additionally, some students manipulated and analyzed existing datasets or samples provided by mentors.
Other	Student Organized Activities: Students organized virtual game nights and some onsite students self-organized hikes and outings (which has been typical in years past).
Ending event	Final presentation: All presentations were given virtually throughout a span of several days over a series of Zoom sessions which lasted approximately 1.5 hours each. Each student or student group was given 20 minutes to present their research projects and take questions.

Rosetta Commons REU: A Cyberlinked Program in Computational Biomolecular Structure & Design

PI: Jeffrey J. Gray; Program Manager: Camille Mathis; General scientific theme: Biomolecular Structure and Design

Website: <https://www.rosettacommons.org/about/intern> Abstract: https://nsf.gov/awardsearch/showAward?AWD_ID=1950697
<https://orcid.org/0000-0001-6380-2324>

Programming

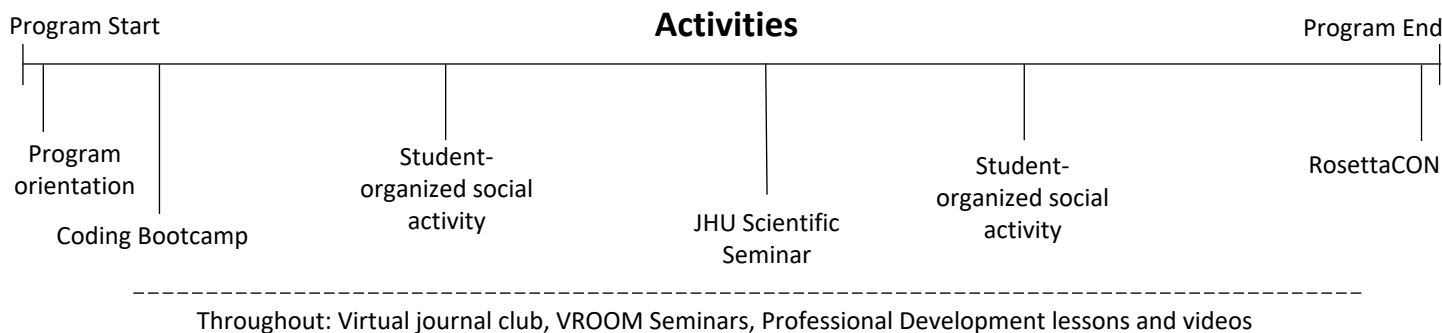
- Nature of research was computational.
- 14 students and 14 mentors
- 10 weeks for 37-40 hrs/week
- Synchronous and asynchronous components

Mentors

- There was one pair of mentors comprised of a graduate student/postdoc mentor and a lab PI who worked collaboratively to mentor one student.

Influence of Pandemic

- Nature of research did not differ from previous years; all projects are always computational.
- No new mentors were recruited as a result of the pandemic.
- Mentors did not have to develop new projects as a result of the pandemic.
- Students did not work in teams as a result of the pandemic, aside from one pair of students who worked collaboratively on their project.
- Typically, students have access to a local REU and participate in their activities, but this year they participated in virtual events hosted by the VROOM group.



Activity Type	Description
Starting event	Program orientation: Students were welcomed and introduced to the program. It was a meet-and-greet structured event, and students participated in ice-breakers to get to know one another. It was a 2-hour long event.
Professional development	Professional Development lessons and videos: Students were given lessons on topics such as how to give an oral presentation, how to take constructive feedback, how to make a poster, how to communicate with their mentor, etc. These were held once a week and typically lasted anywhere from 30 minutes to an hour.
Scientific	JHU Scientific Seminar: A faculty member was invited to speak to students over Zoom. This event was held once and was an hour in duration.
Research	Virtual Journal Club: This is a regular part of the REU in which students present and review journals, and faculty provide a professional-development mini-lesson. The club meetings were held weekly and typically lasted an hour and a half.
Other	Social activities: Students organized these activities amongst themselves. They typically lasted about 2-3 hours and were held two times throughout the program.
Ending event	RosettaCON: This is a regular part of the REU program, but it was held virtually this year. Students attended talks and presented their posters. It occurred once at the end of the program and was held over the span of 3 days.

Teaching plant and agricultural phenomics through unPAK

PDs: Matt Rutter, Allan Strand & Courtney Murren, Evaluator Danielle Jensen-Ryan; General scientific themes: Plant science, Genotype to Phenotype, Phenomics, Agriculture, Evolutionary Ecology; Website: arabidopsisunpak.org

Programming

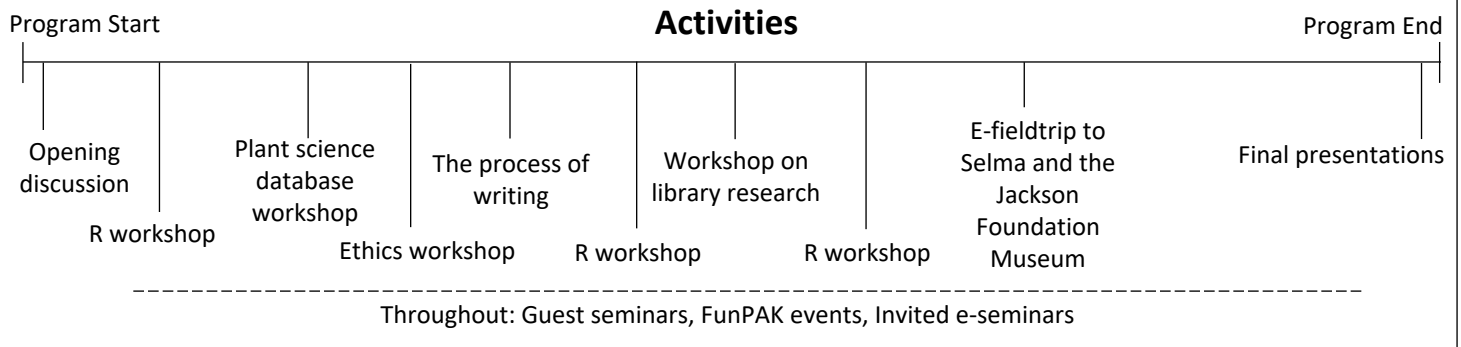
- The nature of research was computational and experiment-based.
- 11 students and 4 mentors and additional home institution mentors
- 5 weeks for 37.5 hrs/week
- Synchronous and asynchronous components

Mentors

- Mentors did work collaboratively with other mentors to guide and advise students, but this was not as a result of the remote circumstances.

Influence of Pandemic

- Nature of research did not change significantly, but it was more computational than in previous years.
- The senior scientist mentorship team was the same as in 2019. However, the Zoom and Slack-based communication enabled home-institution mentors from which summer participants were recruited to be connected during the program.
- Mentors developed an entirely new plant-growth kit for a phenotyping project, along with training videos.
- Students did work in teams or pairs, but not as a result of the pandemic.



Activity Type	Description
Starting event	Opening discussion of expectations and discussions about organizing one's remote workday: These discussions were held briefly and regularly as well as at the beginning of the program.
Professional development	R workshops: These two-hour workshops were held three times throughout the program and went over topics such as data management, graphing, and statistical approaches. Ethics workshop: This one-hour event was held once during the program. Guest seminars: Speakers from diverse career stages, institutions, diverse racial and ethnic backgrounds, and from both the US and other countries, presented to students. There were Q&As on plant science topics, and speakers also spoke of their journey as a scientist. CV development and discussion of the broad framework of USDA program and agricultural careers.
Scientific	The process of writing: This workshop was held formally once during the program and was an hour in duration and was revisited periodically throughout the program.
Research	Workshop on plant science databases: This one-hour event was held once during the program. Workshop on library research: This one-hour workshop was held once during the program.
Other	FunPAK: These one-hour events were held weekly and consisted of games, art, and sharing recipes. Invited e-seminars: These one-hour seminars were held once a week. e-fieldtrip to Selma and the Jackson Foundation Museum: Students virtually visited the house where civil rights and voting rights leaders (including Dr. Martin Luther King) planned and coordinated the Selma to Montgomery March (jacksonfoundationandmuseum.com). The conversation focused on the civil rights era, social justice, antiracism, the impact of young people on the movement, and the connection to voting rights of today. This fieldtrip contributed to students expressing their views and discussing civil rights and social issues.
Ending event	Final presentations: These presentations were day-long oral presentations via Zoom. Team presented outcomes of the two cohort/team projects (~15 minutes followed by 5min Q&A) and individual/pair projects (~10 minutes followed by ~2 min Q&A). Invited guests included home mentors and peers so students could get feedback on presentations.

Training and Experimentation in Computational Biology (TECBio) at the University of Pittsburgh

PI: Joseph Ayooob; General scientific theme: Computational and Systems Biology

Website: www.tecbioreu.pitt.edu Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1659611

Programming

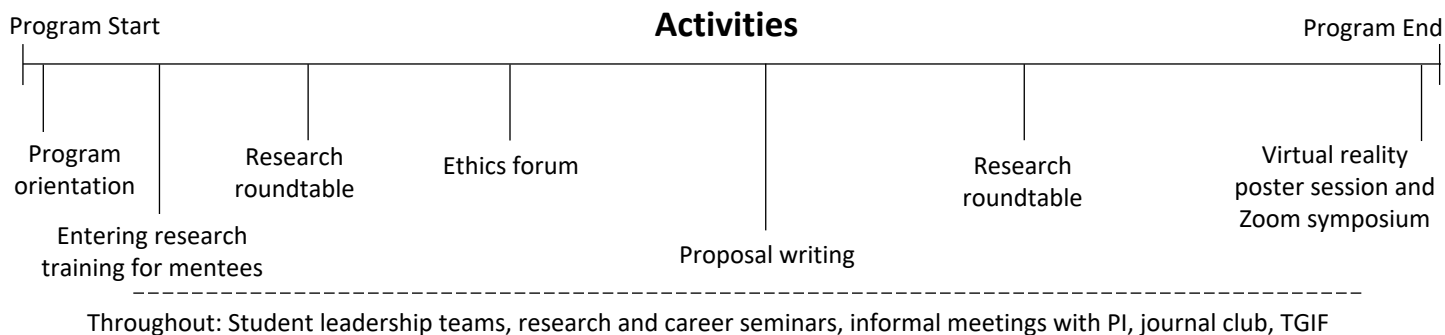
- The nature of research was computational structural biology, cellular and systems biology, genomics and bioinformatics, computational drug discovery, and bioimage informatics.
- 16 students and 15 mentors
- 10 weeks for 40 hrs/week
- Synchronous and asynchronous components

Mentors

- There was one experienced mentor, whose background is mainly experimental. They collaborated with another TECBio mentor to build a model with their student instead of gathering new experimental data.

Influence of Pandemic

- Nature of research did not differ substantially from previous years.
- New mentors were recruited to the site, but they were not recruited as a result of the pandemic.
- The workload for students was slightly decreased; some individual activities became group projects.
- Some students worked in teams, which was new this year; two mentors also worked collaboratively to mentor the same student.
- Program leadership incorporated the use of virtual reality technology to help foster interpersonal interactions among students and program directors.



Activity Type	Description
Starting event	Program orientation: Students were welcomed and introduced to the program. As this was the first meeting together, the program made introductions by forming small groups of students to get to know each other in Zoom breakout rooms, and program and student expectations were discussed in the whole group.
Professional development	Entering research training for mentees: The PI developed a 5-session mini-arc of this curriculum. In these sessions, students discussed their excitement and concerns about their research experience, ways to align their goals and expectations with those of their mentors, challenges facing diverse teams, and ways to handle difficult situations and tasks by relying on the program infrastructure and mentoring circle as well as cultivating their own self-efficacy. Ethics forum: In small groups, students investigated an instance of scientific misconduct, prepared a discussion on the topic, and presented it to students in other summer programs. Graduate students served as mentors for the groups and help them prepare their discussions.
Scientific	Research and career seminars: The program hosted a weekly one-hour seminar series for our students. These sessions introduced students to the various scientists in the field, their research, and their career arcs. Journal club: This event was held weekly; students participated in teams of 2-3.
Research	Proposal writing: Students submitted a 4-page proposal outlining their research goals/hypotheses, methods, alternatives, and significance of expected results by the end of the fifth week. Students wrote these independently with input and guidance of their mentors. Research Roundtables: Twice during the summer, the program hosted discussions where students briefly described their research project/question, its importance, the approach, and any findings they made and/or challenges they are facing.
Other	Student leadership teams: Students each served on two of the following teams to address the specific goals in consultation with a graduate student advisor and the PI: mentoring team, t-shirt team, ambassadorship team, social team. TGIF (TECBIO Games, Interviews, and Fun): These events were networking/social gatherings that ran throughout the program at the end of the week.
Ending event	Virtual reality poster session and Zoom symposium: Students presented their work orally on the second to last day of the program in Zoom, which accommodated the attendance of their friends and family. On the last day, the program hosted a poster session in VR.

A Transformative Approach for Engaging First-Generation Underrepresented Minorities in a Research Experience

PI: Bob Kao; General scientific theme: Microbial & Cell Biology of Animal Development
 Website: <https://www.heritage.edu/academic-paths/special-programs/hu-nsf-reu/>
 Abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1852032

Programming

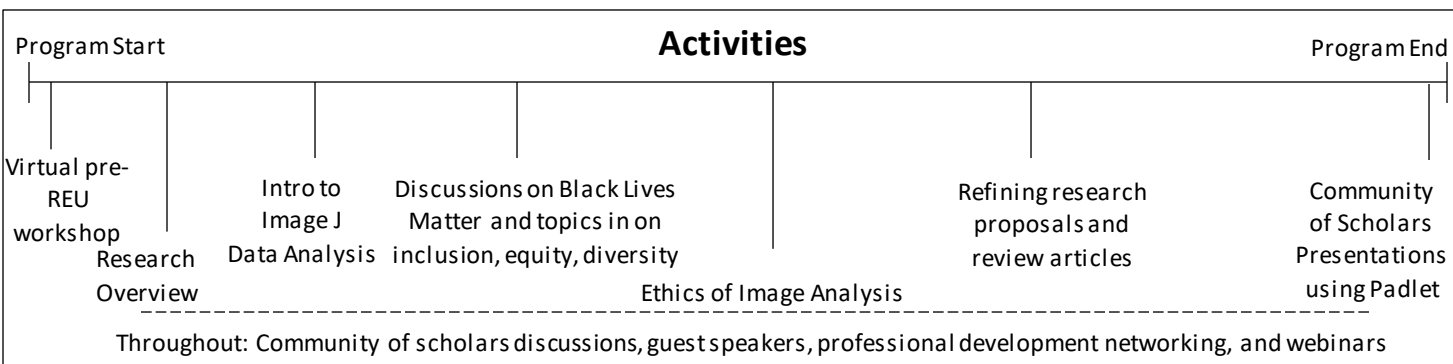
- The nature of research was applied bioinformatics and computational biology.
- 11 students and 6 mentors
- 9 weeks for 40 hrs/week
- Synchronous and asynchronous components

Mentors

- Mentors and the PI collectively helped plan new and adapted research experiences.
- Mentors collectively worked together using a sociocratic model to design new projects for virtual research experiences and collaborated on projects frequently during community of scholars discussions.

Influence of Pandemic

- The nature of research in the past typically included in-person lab studies combined with field studies, however, no in-person lab work nor field studies were permitted due to stay-at-home orders.
- The lab collectively decided to use a systems thinking community framework to plan for an applied bioinformatics remote research summer experience.
- No new mentors were recruited as a result of the pandemic.
- The number of undergraduate participants was increased so that undergraduates could work in teams in the new virtual format.



Activity Type	Description
Starting event	Virtual pre-REU Workshop: The PI and mentors had a virtual workshop for all REU participants for 2 hours each day over the course of three days. During the workshop, adjustments were collectively made to in-person lab techniques, new research proposals were adapted, and participants worked in groups to present a mini research proposal.
Professional development	SACNAS webinars: Throughout the ten-week virtual research program, undergraduates attended webinars on Writing an Individual Development Plan and Harmony in Work and Life. Additionally, three guest speakers were brought in to discuss their own experiences in the field of science and provide input on topics such as communication in science, graduate school, and career paths.
Scientific	Community of scholars discussions: These discussions occurred 4-5 days a week and were typically 2 hours each. Researchers would cover how the applied bioinformatic technique fits into the fields of cell and microbial developmental biology and how to define research questions. This was followed by a step-by-step walk through of ImageJ and how to interpret data from research papers. Additionally, this was typically followed up with an interactive Q&A. The discussion would then end by summarizing the approach and linking it back to the big picture of the field.
Research	Participants were given the option to work in teams to create applied bioinformatics posters which were then displayed in a virtual gallery.
Other	Student pop-up hours via Zoom were provided throughout the 10-week summer research experience to go over undergraduates' topics for their respective research proposals and posters.
Ending event	The program collectively shared research proposals, topics for review articles, and posters on applied bioinformatics using Padlet and Zoom discussions.

FOCUS GROUP QUESTIONS

Student midpoint

1. Briefly tell me about your experience this summer so far – who are you working with? What are you working on?
2. What is one thing about the program that is going well for you?
3. What is one suggestion you have for improving the program or your research experience?
4. Anything else you think it would be important for me or other people involved in the program to know?

Student endpoint

1. What is the most important thing you got out of the experience?
2. As a reminder, here are some of the things you highlighted as going well the last time we spoke: 30,000-foot view of what was going well blurb. Anything to add to that?
3. As a reminder, here are some of the things you highlighted as areas of improvement: 30,000-foot view of areas of improvement blurb. Anything to add to that? Are these still areas of improvement?
4. Is there any aspect or part of the program that you would recommend dropping?
5. If you could give one piece of advice to a student participating in a remote REU in the future, what would it be?
6. If you could give one piece of advice to a mentor in a remote REU in the future, what would it be?
7. Anything else that would be important for us to know?

Mentor midpoint

1. What are one or two things that are going well in the program and/or with your undergraduate researcher thus far?
2. What are one or two suggestions for improving the program and/or your work with your undergraduate researcher for the remainder of the summer?
3. Anything else you think it would be important for me or other people involved in the program to know?

SURVEY MEASURES

Synchronous vs. asynchronous programming

Item: Were events in your program (workshops, guest speakers, etc.) mostly synchronous (live) or asynchronous (recorded)? **Response options:** (1) Entirely synchronous, (2) Mostly synchronous, (3) Both synchronous and asynchronous, (4) Mostly asynchronous, (5) Entirely asynchronous, (6) I prefer not to respond.

Relationship quality (Ragins & Cotton, 1999)

Items: Think of the person that mentored you most in your research this summer. With this person in mind, please indicate the extent to which you agree with the following statements... **Response options:** (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Slightly agree, (5) Moderately agree, (6) Strongly agree, (7) I prefer not to respond.

1. My mentor is someone I am satisfied with.
2. My mentor has been effective in their role.
3. My mentor always met my needs.
4. My mentor never disappointed me.

Connectedness (Rovai, 2002)

With your summer research program in mind, please indicate the extent to which you agree or disagree with the following statements... **Response options:** (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Slightly agree, (5) Moderately agree, (6) Strongly agree, (7) I prefer not to respond. Note: R indicates an item that should be reverse scored.

1. I feel that students in this program care about each other
2. I feel connected to others in this program
3. I do not feel a spirit of community (R)
4. I feel that this program is like a family
5. I feel isolated in this program (R)
6. I trust others in this program
7. I feel that I can rely on others in this program
8. I feel that members of this program depend on me
9. I feel uncertain about others in this program (R)
10. I feel confident that others will support me

REFERENCES

- Ragins, B. R., & Cotton, J. L. (1999). Mentor functions and outcomes: A comparison of men and women in formal and informal mentoring relationships. *Journal of Applied Psychology, 84*(4), 529.
- Rovai, A. P. (2002). Development of an instrument to measure classroom community. *The Internet and Higher Education, 5*(3), 197–211. [https://doi.org/10.1016/S1096-7516\(02\)00102-1](https://doi.org/10.1016/S1096-7516(02)00102-1)