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NSF PHYSICS REU SITE DIRECTORS WORKSHOP
HOUSTON MARRIOTT SOUTH HOBBY AIRPORT
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Workshop Report



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Additional documents related to this report, including the PDF version, are available at:
<http://www.aps.org/programs/education/undergrad/physicsreu/conferences/2016/workshop.cfm>.



American Physical Society

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Executive Summary

On 20-21 October, 2016, approximately 50 directors of National Science Foundation (NSF)-funded Physics Research Experience for Undergraduates (REU) sites gathered in Houston for a two-day meeting to discuss how REU sites can better serve participants, increase access to and inclusion in REU programs, assess participant experiences and overall program success, and work collaboratively toward common goals.

Five overarching themes emerged from the workshop:

Assessment: Assessment includes both assessing the experiences that REU participants have at individual sites, and assessing the REU program as a whole. The shared goals for the REU sites and the overall program include the development of a common assessment plan. This plan will allow individual site leaders to better understand the impacts their own programs have on participants, while also producing aggregate data to help the program director assess the overall program. Program and site leaders recognize a growing need to determine appropriate assessment criteria, both to make the case for continuing and perhaps expanding the program, and to respond to external pressure for NSF-wide program assessment. Program-level assessment goals include determining how well the program is including undergraduates from underrepresented groups and long-term impacts that REU experiences have on participants.

Recruiting: Although many site leaders reported that the number of undergraduates applying for REUs at their institutions each year far exceeds the number of available spaces, many also reported that they did not feel they were adequately reaching underrepresented populations, including underrepresented minorities, rural students and first-generation college students. Site leaders discussed various strategies for improving recruitment of underrepresented undergraduates, including collaborative recruiting efforts, and emphasized that many of these undergraduates respond much better to in-person efforts than to online or print advertising.

Selecting a cohort: Currently each REU program has its own application and selection procedure, including application deadlines, which makes coordination between programs and data collection challenging. Site leaders discussed possible ways to coordinate aspects of the application procedure, such as agreeing to a common earliest date by which candidates must inform sites if they will accept an offer for a position. In addition, leaders discussed how to address ways that application and selection procedures could inadvertently disadvantage traditionally underrepresented undergraduates.

Building a community of undergraduate researchers: Each REU site seeks to form a coherent community among a group of diverse individuals in which everyone is valued and respected. Participants in REU programs need to be quickly oriented to unfamiliar campuses, workplaces, and institutional cultures; to be mentored so they can complete a meaningful research project within a relatively short period of time; and to be supported through challenges they may encounter during the experience. Site leaders discussed ways to effectively mentor undergraduates, and to ensure that all participants are supported.

Building a community of Physics REU Site directors: The 2008 and 2016 REU site director workshops have been excellent opportunities to share effective practices and insights amongst site directors. However, the formation of a lasting community of site directors would foster ongoing discussions and help make the overall program stronger than the sum of the individual sites. Site leaders discussed how this group can continue to share effective resources and

collaborate on improving programs in between in-person meetings, including specific initiatives and organizational structures, and when the next in-person meeting should be planned.

Decisions made and next steps:

- In 2017, all domestic sites will give their first set of accepted applicants until March 3 to accept or reject initial offers. Program leaders will then evaluate the effectiveness of this common first response date and decide whether to maintain it for future years.
- Several working groups were created to address collaborative efforts in:
 - assessing undergraduate benefits, both at the site level and the program level;
 - defining longitudinal outcomes that could be measured to determine if program goals are being met;
 - collecting common recruiting materials (“one-pagers” and “slides”);
 - developing common language for use on websites and in offer letters.
- All sites agreed to provide a list of all applicants’ email addresses in order to determine the number of unique applications for physics REU site opportunities.
- A Google group for site leaders was created.
- A leadership group was created and chairs selected.
- The next in-person site leader meeting will be held in 2019–2020.

Welcome and Update on NSF REU Program

Kathy McCloud, NSF Program Manager

Kathy told site leaders that she wants information on how to sell the program to others at NSF and beyond. There are currently 420 to 500 physics REU participants per year, depending on how you count. Undergraduates complain—and data corroborate—that it's harder to get accepted into a physics REU site than into a physics graduate program. The REU program is a priority within NSF Physics, but with the flat budgets NSF and other agencies have been seeing, there are currently no funds to expand the program. Kathy would love to expand the program in the future if she can sell the program effectively, which would require data showing how much unmet demand exists for the program, and that it is effective.

Kathy also noted that there is increasing external pressure to assess the NSF REU program as a whole. Her comment to the physics site leaders was that either they can suggest how the program should be assessed or others will—and the physics community might not like the result. Assessment will require figuring out how to track participants longitudinally, to determine what the long-term impact of an REU experience is. Even if everybody believes the impact is positive, evidence is needed to back this up.

Separately, Kathy noted that one of the most common complaints she hears from undergraduates is that they often have to decide whether to accept one offer before learning whether they are accepted at other places to which they applied. She suggests that physics site leaders consider a common deadline for undergraduates to accept or reject initial offers as a way to alleviate this.

Impact and Outcomes of Undergraduate Research Experiences

Sandra Laursen, University of Colorado Boulder

Sandra pointed out that the REU is an apprenticeship model, in which the undergraduate does something with an expert that contributes to a scientist's work. Everybody has a vested interest in the research—nobody knows the answer and everybody wants to get to it. As a result, the undergraduate is able to start developing the skills and behaviors of a scientist. Maybe the mentor is protecting the undergraduate from some aspects of the job, such as seeking funding, but the science is still the real deal.

We would like to measure the extent to which undergraduates are adopting professional identities as scientists, learning to think like scientists, and gaining confidence in scientific skills. These are hard to measure—we cannot simply hook undergraduates up to a brain scan. We need a well-written, validated tool such as the Undergraduate Research Student Self-Assessment (URSSA), which can measure student self-reported gains in these areas. These types of assessments can also help identify when participants had positive experiences in their apprenticeship, or experiences that helped them realize they do not want to pursue a career as a



research scientist. These successful experiences may be missed if programs simply count the number of participants that pursue science, technology, engineering and mathematics (STEM) research careers.

We also need to assess both the scholarship produced in REU programs and the progress toward educational goals of such programs. Generally speaking, the latter type of assessment is often ignored or downplayed in scientists' assessments.

The goal of assessment is not to compare programs, but to determine whether a particular program is achieving its goals. One powerful aspect of URSSA is that the aggregate data from multiple REU sites can be used to assess the Physics REU program as a whole. Site directors can also customize the tool to meet their needs.

Assessment Practices

Catherine Mader, Hope College

Site leaders discussed what aspects of their programs they would like to measure. Some metrics that were mentioned include:

- Outcomes for REU participants, such as whether they go on to graduate programs or other kinds of positions;
- How REU participants do in graduate programs relative to non-participants;
- How well REU sites are including underrepresented groups, such as:
 - underrepresented minorities (Hispanics, African-Americans and Native Americans)
 - women
 - first-generation college students
 - community college students



One strength of the NSF Physics REU Site program is the diversity of the individual sites. While the above metrics are appropriate for the program as a whole, each individual site does not need to excel in every aspect. It is important for each site's leaders to define their goals and identify which metrics are relevant to their site.

Recruiting, Training, Supporting, and Rewarding Mentors

John Mateja, Goldwater Foundation; Mario Diaz, University of Texas Rio Grande Valley

John pointed out that for any program to be successful, it has to be productive for overworked faculty who need to teach, do research, and do service in order to achieve tenure and promotion at their institutions. For REU programs, this means that faculty may need to be convinced that they as well as an undergraduate will benefit if they accept an REU participant. One researcher engaged REU participants in high-risk or exploratory projects that they were hesitant to give to graduate students. The summer research program thus helped the faculty member explore many new areas, and occasionally led to new directions for their overall research program.

REU participants cannot simply be placed in a lab. They may need strong mentoring and support to succeed in what is likely to be their first research experience. John recommends that site directors visit labs hosting REU participants frequently, at least once a week, to check on progress and address developing issues before they become larger problems.

Research Mentor Training Workshop Preview

Eric Hooper, University of Wisconsin-Madison

Eric described a research mentor training workshop whose purpose is to help faculty actively think about how to mentor researchers at all levels. Thoughtful mentoring has numerous benefits: Well mentored undergraduates are more successful, less stressed, more likely to stay in a program, and more likely go on to advanced degrees. It can also lead to better funding of non-REU grant proposals, especially now that NSF requires mentoring of postdoctoral researchers on traditional research grants.

As with REU programs, mentoring workshops need to clearly benefit faculty members and fit into their busy schedules. Some will attend a full-day workshop; others may have time for only a 90-minute session. Encourage them to come by telling them their experience is needed. In addition, the workshops can be adapted for non-faculty mentors, including senior undergrads, graduate students, and/or postdoctoral researchers who may also mentor REU participants.

Research mentor training materials are available on the APS website at <https://www.aps.org/programs/education/undergrad/faculty/mentor-training.cfm>

Recruiting Undergraduate Researchers

Steve Turley, Brigham Young University

Sites leaders discussed what activities are effective or not for recruiting REU applicants, with an emphasis on underrepresented students. There was agreement that for many underrepresented students, “conventional” advertising strategies such as Web ads, brochures, posters, print ads in bulletins of the National Society for Black Physicists (NSBP) and National Society for Hispanic Physicists (NSHP), etc., don’t really work. You have to visit undergraduates personally. They may not want to go far from home, and their families may expect them to earn money over the summer or have year-round jobs. This means it is critical that undergraduates get the message that an REU will pay money and advance their careers. Visiting undergraduates’ home institutions also gives site leaders a better perspective on their undergraduates’ realities.

One site leader has learned that he often has to shake an undergraduate’s hand twice before they will apply. He also mentioned a colleague who needed to visit an undergraduate student’s mother at her home in another state to convince her that her son would be safe at the REU site if he took the REU offer.

Another site leader noted that recruiting “collectively” could help sites reach underrepresented students who don’t find REU programs and apply on their own. She suggested that all sites make one-pagers for their programs that can be aggregated into a document with a cover page explaining why undergraduates should consider summer research.

Training Undergraduate Researchers

Alex Crowell, Duke University

Ideas were shared that covered four main areas for training undergraduate researchers: (1) “jump starting” the REU experience with training activities in the first couple of weeks, (2) monitoring participant research progress and assessing the REU experience in real time, (3) providing activities for “intellectual broadening” during the program, and (4) preparing participants for their “research deliverables,” which might include written reports, posters, and oral presentations.

To facilitate building the mentor-undergraduate relationship and preparing the participant for their individual research project, PIs can skype or phone with undergraduates even before the program formally begins, to get to know one another and to provide background reading material about the project. One site requires a three-to-five-page research proposal before undergraduates arrive, so they can hit the ground running.

Once on campus, it can be beneficial to have an experienced undergraduate facilitate an icebreaker session and organize social opportunities for REU participants. This experienced undergraduate often becomes someone whom REU participants feel comfortable coming to with personal issues and concerns. Participants should also receive safety training, learn tools and software, read background literature, and take workshops and bootcamps for software and lab equipment they will need.

To monitor undergraduate progress, it can help to have participants give talks about their research throughout the summer, to ensure they are on the right track. Another option is having participants write blogs about their projects or do weekly journaling that are submitted to someone in the program.

Numerous opportunities exist to broaden undergraduate students’ experiences, including attending academic conferences; touring local industrial, academic, and governmental research facilities; attending a “career day” where they hear from past program alumni about various physics careers; and attending science writing or communication workshops. Some sites have participants do a mock NSF Graduate Research Fellowship Program application, which also makes them aware that this program exists. (They could also do a mock Goldwater Fellowship or other application.)

Many programs have participants give final oral presentations and/or prepare a Physical Review-style research paper on their research.

Supporting Undergraduate Researchers

Sherry Yennello, Texas A&M University

REU participants can encounter an almost unlimited number of situations while on campus, and it is the responsibility of site leaders to prepare undergraduates for how to handle challenging situations, provide support when situations occur, and, to the extent possible, protect undergraduates from discrimination and harassment. The federal statute known as Title IX provides some guidance as to what a university is legally required to do to ensure women have equal access to educational opportunities. But Sherry noted that we shouldn’t need Title IX to tell us what to do, and we should go above and beyond what is legally required. Site leaders

should strive to create a supportive community of diverse scholars in which everyone is valued and respected.

Site leaders need to make sure participants know who on campus they can talk to. Find out who these people are and make undergraduates aware of them on the first day of the program. These should include a university ombudsman, faculty who are prepared to support participants, and, if available, graduate students or others closer in age to REU participants, and with whom they may be more comfortable speaking. “Allies” programs are also becoming more common. Allies can watch and support participants when many incidents actually happen, e.g., at parties or after parties, when faculty are unlikely to be present.



Site leaders should be aware of potential religious issues and how they could impact REU participants. If Ramadan falls over the REU period, for example, scheduling a lunch activity could exclude some participants.

Site leaders need to be aware of disabilities, including learning disabilities and invisible disabilities. In the lab, ergonomics experts can help design physical environments that enable access and minimize potential health problems, e.g., from repetitive stress injuries. Nontraditional students may also need special accommodations; for example, parents with children are unlikely to be able to stay in a standard college dormitory. Kathy McCloud noted that funding supplements are often available for accommodations for participants who need them, especially for housing needs.

Participants can form cliques that can exclude some participants, especially ones who may be minorities in some way. Be aware of these, and take proactive steps to ensure that REU participants are not becoming socially isolated. Graduate mentors or people in those roles, especially younger people, may be more in tune to social realities of REU participants, including on social media.

What Does Access Really Mean?

Mary James, Reed College

Mary told an inspiring story about how mentors helped her at critical points on her journey to becoming a physicist. The main takeaway is that it is too easy to see access as simply accepting undergraduates into a program. But if you do not meet all students where they are and support them to grow and succeed, you have not really provided access. True access requires meeting students where they are and figuring out what they need to take the next step in their careers.

Social psychologists have identified a number of phenomena that hinder undergraduates, especially underrepresented students, from achieving success in physics and other areas. These include impostor syndrome, stereotype threat, belongingness uncertainty, and a fixed mindset (vs. a growth mindset). James encouraged all mentors to learn about these phenomena and how they could impact REU participants.

Collaborative and Cooperative Efforts

The rest of the workshop was dedicated to discussions on how to formalize decisions and create structures to facilitate future collaboration among REU physics site leaders.

1. Common assessment efforts

The working group on assessment efforts will pursue two projects. The first effort will review the URSSA instrument and identify a bare-minimum core set of questions that address REU sites and program goals defined by the workshop participants. Working group members will share their work with the full group for feedback.

The working group will also work with URSSA developers to understand technological and logistical details associated with implementing a system that would allow all site directors to utilize the assessment's core elements while adding custom questions of relevance to their site's unique goals. They will also work with the URSSA developers to identify the costs (short and long term) associated with pursuing a common assessment program. Working group members will report back to the larger group if additional efforts are needed to carry this out. The goal would be to have the aggregate results from the core questions shared with the program officer, while individual site data would be shared only with the site director for that site.

The working group also discussed longitudinal outcomes they would like to measure. They will continue to work on developing a set of survey questions that would address the impact of the REU program on undergraduates' career paths, and report back to the group. It was acknowledged that this would require being able to track participants three to six years after their REU experience. However, it was pointed out that the NSF REU Site program is currently developing a mechanism for tracking REU program participants. Thus the working group will assume that tracking participants will become possible, and will focus on defining outcomes and developing survey questions to be used once the tracking challenge is solved.

2. Common application deadlines or offer dates

Site leaders agreed that setting a common date by which undergraduates must accept or decline their first offers is much better for undergraduates, who can then choose where they want to go with full knowledge of what their options are.

Astronomy REU programs all make first offers on March 1, and ask undergraduates for responses within one week. Not all sites have the same application deadline, because site leaders take different amounts of time to process applications.

A vote was taken, and all site leaders present agreed that they will not require responses to initial offers before March 3, 2017. Sites can set any application deadline they want and send offers whenever they want, and undergraduates can accept or decline before March 3, but a response cannot be required before that date. The working group that developed this proposal will provide site leaders with sample wording to include on websites and in notification letters.

It was recognized that international programs need more time because of passport requirements, etc. They will not be expected to adhere to this common date. Others who feel that this date will not work for their sites are encouraged to share their concerns with the NSF Physics REU Sites program office. **It was agreed to try this for 2017 and see what works and what needs to be improved in future years.**

3. Measuring demand for REU opportunities

Currently each REU program has its own application and selection procedure, which makes it challenging to coordinate between programs and collect data about the applicant pool. There was some discussion of the possibility of a common portal for all physics REU applications. This would allow program leaders to gather certain demographic data, which could help assess overall demand for the program and whether it is recruiting a diverse group of applicants.



However, some concerns were expressed, including that a common portal could deter certain applicants or weaken personal links between potential applicants and individual site leaders, or that if set up incorrectly, applicants could too easily apply to all sites. At this time, there is no plan to create a common application portal.

Site leaders did, however, agree to provide email addresses of all applicants from their 2016 program to the leadership group, to enable program leaders to determine the number of unique applicants for Physics REU sites and the typical number of applications per applicant. This will allow the NSF and program leaders to assess demand for physics REUs. Ted Hodapp noted that the leadership team has already obtained IRB approval for this study, which ensures that privacy issues are addressed appropriately.

4. Recruitment

Many site leaders expressed interest in a collaborative effort to advertise at SACNAS/NSBP/NSHP conferences and others, as well as in *Physics Today*, which offers free advertising for undergraduate-focused programs. In addition, whenever a site leader does publicize their program at conferences or specific institutions, it would be helpful if they shared information about all of the physics REU site programs. To facilitate this, site leaders who wish to have their programs included in these types of presentations can create a single slide or one-page program descriptions that can be incorporated into presentations or handouts. Site directors interested in doing this should submit their materials to the PHYSICS REU SITE DIRECTORS Google group folders.

A webinar to explain to undergraduates how to apply for summer research programs was also discussed. APS has hosted such a webinar in the past.

5. Alternative ways of evaluating candidates

Since we are trying to increase traditionally underrepresented groups' access to REU programs, we may need to adapt our metrics for evaluating applications, which were designed to select from traditionally well-represented groups. For example, research has shown that using a GRE score as a first filter for graduate school is likely to keep out underrepresented groups. Are there similar problems with the current metrics used for selecting REU participants? How are sites identifying candidates who don't fit the traditional mold? As an example, Vanderbilt has one or two individuals reading all applications to look for undergraduates with grit and determination that might be missed using traditional metrics, and ensure that these applications are considered.

Similar issues may also exist within the traditional reward structures in our REU programs. If sites provide end-of-summer awards to some participants, for example, site leaders should ask whether the metrics used for these awards recognize the grit and determination of undergraduates, rather than simply focus on traditional skills with which some participants may have had more previous experience than others.



6. Planning for the future

A leadership group has been defined. For this next year, Sherry Yennello is past chair, Cathy Mader is chair, and Garfield Warren is vice chair. The term of service is one year, and elections for vice chair will occur yearly. The design then rotates with the chair becoming the past chair and the vice chair becoming the chair in the following year. **Site leaders gave unanimous consent for this leadership structure.** One task of the leadership group will be to write a set of “bylaws” to define the roles of each of the positions, and to design a process for how this is accepted or modified.

Leadership group members will write a proposal to NSF to fund modest staff support from APS for community activities, and funding for a subsequent workshop. They also propose to reconvene the Physics REU site directors in three years, noting that energy would likely start to dissipate with a longer time interval.

A Google group was set up for sharing documents and communication within the community. All site leaders have received an email invitation to join the group and resources and references shared during the workshop will be posted in the group’s Google folders.

Appendix A: Acknowledgements

This report summarizes the second workshop of Physics REU Site Directors. The workshop was supported by the National Science Foundation through a grant to the American Physical Society (Grant Number-1623204). The workshop was organized by a committee of REU site directors (past and present) and the American Physical Society.

We would like to thank Kathleen McCloud, the program director for the NSF Physics REU Site program for her support of this workshop and of the Physics REU Site program. In addition, we thank Gabe Popkin for attending the workshop and writing this report. We also thank Kathryn Woodle and Ted Hodapp at the APS for their support and insights from the earliest stages of the project and continued support of the Physics REU Leadership group into the future.

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Appendix B: Workshop Program

| Thursday, October 20, 2016 | | |
|----------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| 8:00 a.m. | Defining Goals of REU Site Programs (for students, faculty, sites) | Cathy Mader , Hope College |
| 8:45 a.m. | Welcome and Update on NSF REU Program | Kathy McCloud, NSF Program Manager |
| 9:00 a.m. | Impact and Outcomes of Undergraduate Research Experiences | Sandra Laursen , University of Colorado Boulder |
| 10:00 a.m. | Measuring Success - Assessment Practices | Cathy Mader , Hope College |
| 11:15 a.m. | Recruiting, Training, Supporting, & Rewarding Mentors | John Mateja , Goldwater Foundation; Mario Diaz, University of Texas Rio Grande Valley |
| 12:15 p.m. | Research Mentor Training Workshop Preview | Eric Hooper , University of Wisconsin |
| 1:30 p.m. | Recruiting Undergraduate Researchers | Steve Turley, Brigham Young University |
| 2:30 p.m. | Training Undergraduate Researchers | Alex Crowell, Duke University |
| 4:00 p.m. | Supporting Undergraduate Researchers | Sherry Yennello, Texas A&M University |
| 5:00 p.m. | Wrap up Discussions and Questions From the Day | Cathy Mader , Hope College |
| Friday, October 21, 2016 | | |
| 8:00 a.m. | Setting the Day's Agenda (working breakfast) | Cathy Mader , Hope College |
| 8:30 a.m. | What Does Access Really Mean? | Mary James , Reed College |
| 9:30 a.m. | Collaborative and Cooperative Efforts I | Theodore Hodapp , APS |
| 11:00 a.m. | Collaborative and Cooperative Efforts II | Cathy Mader , Hope College |
| 12:30 p.m. | Planning for the Future | Steve Turley, Brigham Young University; Sherry Yennello, Texas A&M University |
| 2:30 p.m. | Wrap up the Meeting's Big Ideas and Questions | Cathy Mader , Hope College |
| 3:00 p.m. | Closing Remarks | Theodore Hodapp , APS |

Appendix C: Workshop Participants

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