GEO REU PI Workshop:
Developing an REU Community and Best Practices Through Networking

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We present here a summary of the workshop entitled “GEO REU PI Workshop: Developing an REU Community and Best Practices Through Networking” held in San José, California, on 26-27 September 2011. There were 76 participants at the workshop representing 85% of the invited REU or similar programs. This workshop was funded by the National Science Foundation Program (NSF) grant #1148677. Here, REU refers to Research Experiences for Undergraduates, and GEO refers to the Geoscience Directorate.

**Motivation for the Workshop**

Research shows that research experiences for undergraduates are key to engagement of students in science, helping students to gain practice in professional skills, think like a scientist, and take interest in graduate school (Seymour et al., 2004, and summaries in Taraban and Blanton, 2008; Boyd and Wesemann, 2009; Lopatto, 2010). In addition, gains in personal development result: students are better able to work independently as well as collaboratively and also gain self-confidence (Seymour et al., 2004; Lopatto, 2008, 2010; Trosset et al., 2008). Students involved in undergraduate research are also more likely to enroll in graduate school and to seek additional research experiences (Hathaway et al., 2002).

Nonetheless, undergraduate research is a time and resource intensive activity for faculty, universities, and sponsors. Leaders of Research Experiences for Undergraduates funded by NSF and other agencies are spread out across the nation and work to some extent in isolation from each other. There is a need and desire to develop a community amongst REU leaders for the purposes of leveraging knowledge about best practices to other REU sites, developing collaborative efforts, and providing support to each other.

The mission of this workshop was to bring REU leaders together to meet face-to-face to discuss these issues, and develop community in person. A secondary goal was to connect the REU community with the SACNAS (Society for Advancement of Chicanos and Native Americans in Science) community by co-locating the REU workshop with the Annual SACNAS meeting, and to encourage participation in that conference. SACNAS is a minority-serving science organization that is aimed at supporting Latino or Hispanic and Native Americans in the sciences.

**Introduction and Goals**

Individuals and teams leading internships for undergraduates such as NSF’s Research Experiences for Undergraduates (REU) are deeply committed to running programs that provide clear benefit to the students. Such programs require year-round planning and execution and multiple layers of resources and support. At the same time, many REU programs have common elements that can benefit from best practices established by successful programs. The primary risk to programs are...
that balancing the high demands on these leaders along with the other demands of faculty work can result in burnout and discouragement.

The workshop was convened to explore potential collective gains achieved by working as a peer group. The goals of this workshop were to:

1. Promote community building by providing participants with multiple opportunities to interact with other PIs within their division, as well as PIs who share challenges or have experience with issues pertinent to them.
2. Promote the sharing of experiences, insights, and other perspectives on what works well for different aspects of running REUs. The intention was to encourage PIs to plan some steps for improving their programs.
3. Develop recommendations for mechanisms that would enhance communication among geoscience REU leaders, including networking, the sharing of effective practices, and proving mutual support.
4. Introduce REU leaders to one minority science organization, SACNAS through participation in a few SACNAS conference events. The pre-workshop survey indicated that recruiting diverse students was a topic of great interest, thereby supporting this goal.

Fig. 2. REU leaders spent a significant portion of the workshop sharing strategies and developing a sense of community.

**Workshop Participation**

Leaders and staff from 67 GEO REU sites from across the United States and Puerto Rico were invited to the workshop. We pursued representation by each REU through persistent contact with invitees, and searching for alternative participants when the invited REU leader could not attend. The end result was that 57 of the 67 (85%) invited NSF REU internship programs were represented at the workshop. The breakdown of NSF-GEO Division affiliations of those programs was as follows:

- 57 of invited 67 GEO REU leaders were represented (85%), including:
  - 17 from AGS
  - 18 from EAR
  - 21 from OCE
  - 1 from OEDG
- 65 leaders from those REUs and 10 from other agencies participated
A list of workshop participants is included in Appendix A. The represented REU programs ranged from those that were in their initial award period to others that have operated for more than 20 years. The total number of workshop participants was 75, about 50% more than anticipated, including 64 leaders from the 57 GEO REUs. The other participants included individuals representing the Institute of Broadening Participation (IBP) (2), GeoCorps America (1), the NSF (5), a science education Ph.D. student, a member of COSEE, and a community member from SACNAS.

The strong participation indicates interest for a meeting of this focus. Support by the National Science Foundation including travel, lodging, and several meals for participants provided an additional incentive, as many people would not have been able to participate without that support.

Fig. 3. A map showing the distribution of NSF REUs in the Geosciences Directorate across the U.S. and Puerto Rico. 85% of the REUs were represented at the workshop.

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“I thought that the REU workshop was essential. I benefitted tremendously from the sharing and the exchange I had with my colleagues. The workshop experiences and interactions have helped to enhance the execution of my PI duties and my overall REU program.” - Workshop participant.

Workshop Organization

The workshop took place 26-27 October 2011, in San José, California, at the Fairmont Hotel. The organizing committee included three REU leaders, from each of the three Divisions of the NSF Geosciences Directorate, along with the RESESS Internship Program Director at UNAVCO, Valerie Sloan. The Steering Committee included:

• Dr. Valerie Sloan (OEDG), UNAVCO
• Dr. Patricia Kelley (EAR), University of North Carolina Wilmington
• Dr. George Boehlert (OCE), Oregon State University
• Dr. Daphne LaDue (AGS), University of Oklahoma

The Steering Committee provided leadership on the structure and content of the workshop, planned the pre- and post-workshop surveys, selected and invited speakers, and served as session co-chairs and discussion leaders at the meeting. In addition, Ms. Shelley Olds from UNAVCO, Dr. Rajul Pandya from UCAR, and Dr. Cathy Manduca from SERC provided invaluable insights into organizing and planning the workshop.

A central webpage was developed as a resource for potential participants. UNAVCO hosted this web page and maintains it as part of their web archive. The webpage was used for providing information to participants about the workshop background, goals, and logistics. The workshop information can be accessed at:

“Thank you for the opportunity and all the time and effort that went into making it happen. I really enjoyed coming to this workshop. I felt like it was organized well, kept on track and to schedule, and supported great interaction and collaboration.”

– Workshop participant

**Workshop Agenda**

The steering committee created a pre-workshop survey to identify topics of interest. The pre-survey had 55 responses, an almost 100% response rate for the 57 programs participating. There was clear direction from the participants about which topics were most interesting to them. Recruiting diversely, tracking interns, and program evaluation ranked as the top three. The steering committee used information from the pre-workshop survey to define five plenary sessions, as follows (see Appendix B for the detailed agenda).

**Plenary Session Topics**

1. How to Create Inclusive REUs
2. Structuring an REU program, Mentoring and Preparing Interns
3. Cohort Building & Tracking Past Participants
4. Program Evaluation
5. How can we help each other?
   a) The Common Application
   b) Ideas for the GEO REU community

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**Fig. 4.** A screenshot of the UNAVCO-hosted webpage for the GEO REU Workshop. The website served as a tool for logistical planning and is currently an archive of the meeting.

**Fig. 5.** Pre-workshop survey results indicating level of interest for workshop topics. 3 indicates being ‘very interested,’ 2 being ‘somewhat interested,’ and 1 being ‘not interested.’ 55 REU programs responded.
Workshop Format

The meeting opened Wednesday afternoon with an opportunity for informal sharing of existing practices and challenges via a poster session. Most participants brought and presented a poster about their REU programs (Appendix C). The 46 posters remained on display throughout the meeting, continuing to spark discussion. Dinner featured a keynote presentation by Dr. Rajul Pandya (UCAR) on “Launching Tomorrow’s Citizen-Geoscientists,” followed by the first of five workshop plenary sessions. After dinner, Plenary session 1 “How to Create Inclusive REUs” featured talks that both challenged the REU leaders to question their own biases in how they engage and work with diverse students and offered ideas on where to recruit them.

Day one concluded with discipline-based discussion breakout groups, each led by a Steering Committee member from the relevant NSF GEO division. Through this interactive session, group members became acquainted with colleagues from their discipline, and identified challenges they wanted to see addressed during the meeting. Topics raised included minority recruitment, long-term program effects on leaders, NSF’s expectations, the idea of a common application, and the intern selection and matching process.

Each plenary featured two or three ten-minute presentations by speakers with interest and expertise in that area who were selected from speakers who self-identified in the pre-workshop survey. This kept the pace moving, and allowed for many topics to be covered. The slides for all twelve talks are available online at the workshop website.

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“I loved the 8-10 minute talks with 3 per session. The 45 min followed by discussion was excellent. Each was concise, to the point, useful.”

– Workshop participant

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Breakout groups following the plenary talks were organized according to REU geographic location to foster interaction among potential colleagues in the same region, or most often by Division. Ideas from the breakout groups were recorded on Google Notes and on large sticky notes that were posted on the walls, making them available for viewing and discussion by others. Participants were also encouraged to join round-table discussions over breakfast and lunch on topics with more restricted appeal such as PI and mentor burnout, and ethics training.

During the evening of the second day, participants were encouraged to join the SACNAS opening ceremonies and dinner as well as the “ Conversations with Scientists” event. A preview of the SACNAS meeting and an introduction to the SACNAS community was provided following lunch on Thursday. Based on a post-workshop electronic survey, 87% of workshop participants attended SACNAS activities that evening. Many GEO REU PI meeting participants remained for SACNAS activities on Friday, October 28, gaining new experiences related to diversity in science.

Fig. 6. Discussions about mentoring were rich and provided REU leaders with new ideas and a sense of support.
Workshop Findings

For each of the five plenary sessions and breakout group, valuable suggestions were provided based on the experience and expertise of the speakers and the discussions amongst REU leaders. Each group was assigned a scribe who sent meeting notes to a centralized email address. In addition, two participants shared detailed notes. These contributions are summarized here with the intent of sharing insights and concerns identified at the workshop.

1. How to Create Inclusive REUs

The first plenary session focused on how an REU program can become inclusive. Session participants indicated that REU leaders should ask themselves questions around their own assumptions in seeking, vetting, selecting, and working with students from diverse backgrounds. REU leaders were asked to consider where they might have barriers in their application process, technological barriers, language barriers, the kind of questions asked, and the requirement for essays. REU leaders were encouraged to consider who makes the decisions about whom to accept, to find out what the students’ personal issues are at the outset (after acceptance), and to reconsider criteria for success.

Ashanti Johnson from the Institution of Broadening Participation (IBP) described ways to recruit from groups that are underrepresented in the geosciences that include using the IBP website for registering programs and advertising on minority science organization websites.

2. Structuring an REU program, Mentoring and Preparing Interns

Plenary session 2 had three components to it. Feedback on all three elements was rich and has the potential to frame best practice. They are summarized below.

Structuring an REU Program

Session participants suggested that in planning an REU, it is helpful to have the following elements in place prior to the start: a schedule, milestones, and events.

- **Schedule**: This is typically a list of the week-by-week activities. Mentors and students sometimes request that calendars be provided in calendar format, as well as list format.
- **Milestones**: Examples of milestones include writing assignments, completing data collection, or presenting a poster. Milestones keep both the student and mentor on track and provide a sense of making progress and accomplishment.
- **Events**: Examples include a welcome dinner, workshops, or field trips, all of which can support the developing of a sense of cohort.

Participants pointed out that choosing program elements depends on the desired outcomes, the leaders’ philosophies on what is effective, and the resources available. The limited amount of time of REU annual programs also makes it difficult to implement all desired program elements (An REU program is typically six to eleven weeks in length).

The question was raised of whether collaborative research projects work well for students. One REU leader stated that students report getting more out of group research projects than individual research experiences. As a secondary project, collaborative research projects have been found to be a distraction from the student’s main project focus, and mentors push back.
**Mentoring**

Participants agreed that mentoring was identified as a critical, but complicated, element of any REU. Research mentors are key to advancing students’ understanding of the research process. The level of commitment of mentors has a direct impact on most mentees. Dr. Russell Cuhel summarized how REU leadership can most effectively recruit and interact with mentors and also posed thoughtful questions designed to encourage discussion among the workshop participants.

Dr. Cuhel outlined that there is a progression one takes in becoming a mentor. First one is a teacher, next an enabler, then an advisor, and finally one becomes a mentor. Each step adds depth, making mentorship important, relevant, and exceptional mentorship is rare. Teaching is not mentoring, advising is not mentoring; instead mentors help students adjust their opinions to reality. As mentors, we must help students understand the necessary skills and reality of what it takes to stand up to the competition. The best mentors incorporate the following into their relationships with students:

- Mentors show students how to think outside the box, to think about opportunities that the student might not have previously considered.
- Mentors need to talk about how hard it is to do many things well. For example, the realities of having a family and a workload that involves teaching, research and travel, medical issues, and more can be challenging. Mentors need to have honest conversation on the realities of balance. Using personal examples is an excellent way to relate.
- The mentor will want to know what the student’s concerns are. Good mentoring is a dialog between student and mentor.
- Mentoring persists beyond the prescribed activity. This means that the relationship developed during the research experience continues beyond the internship time period.
- The mentor shares their professional network of contacts and introduces the student to people who can provide benefits, perspective and input on their professional aspirations.
- Mentors display quality interactions with other people. This models for a student the proper attitudes and how to interact professionally within their field.

Other points raised by the speaker included both thought provoking questions and suggestions for thinking outside the norm.

- How can REU programs challenge faculty to raise their participation to the level of mentoring? Does providing faculty mentors with greater acknowledgement after the internship program help to motivate them to stay connected to the students and to return as a mentor in subsequent years?
- REU leadership should allow the best mentors to take multiple students and support teams, and avoid using mentors who do not provide students with what they need.
- Leadership of REU programs should consider graduate students as potential mentors. Some graduate students function as mentors better than faculty because they are able to better relate to students. Engaging graduate students as mentors also provides professional skill-building benefits to the graduate students.

After the plenary session, participations engaged in rich discussion on the mentoring of interns and mentoring mentors. Multi-tiered mentoring was suggested as being effective. This may involve the student having a science mentor and a graduate student mentor, or having multiple mentors such as a science, writing, and computer mentor, depending on the structure of the REU program. This structure provides a lot multiple avenues of support for the intern and is particularly important if it becomes apparent that the science mentor is weak; although in such
cases, the roles and responsibilities between mentors become less clear. It is helpful to have a graduate student or program advisor not serving in a mentorship capacity who checks in with each student.

Mentoring over a short time period, as most REU programs are, is a challenge. Matching mentors and students early on in the selection process can be helpful. Facilitating pre-REU conversations and having the mentor send a few articles to the student to read prior to the start of the internship can help. In the mentor-student selection and matching process, the process can be student-driven, mentor-driven, or a blend of both. Having engaged, enthusiastic participants (mentors and students) increase the chance of successful pairings.

Further suggestions from the participants focused on providing information and support to mentors. This is especially critical for individuals who have either not been a mentor in the past or perhaps have struggled with mentoring in past experiences.

- During the mentor recruitment process, discuss the weekly schedule with mentors, and the intent of the program, so that you have their buy-in. Encourage them to think of themselves as mentors.
- Define expectations for mentors early on and on paper. Having a written record, or email documentation to refer back to is helpful both for mentors and REU leadership. It also decreases miscommunication.
- Be honest about amount of time needed with intern. Many mentors vastly underestimate the amount of time being an effective mentor takes.
- List deliverables, outline deadlines, and be clear about your expectations of their participation in the program with respect to reviewing student work or assisting the student with making progress on their project.
- In dealing with non-performing mentors, consider meeting with the mentor, mid-stream correction, and not inviting the mentor back. Frequent and honest communication is critical so that the true challenges can be identified and a plan developed to get the mentor/student relationship back on track.
- Consider holding brown-bag lunches for the mentors to give them a forum for discussing issues with their mentoring peers.
- Consider pairing experienced with new mentors to provide a support structure for the mentors. They may be better positioned to assist each other due to the shared experience.

**”The discussions with other REU directors on how to communicate with the mentors about which students the REU program ought to be serving [were effective]. Mentors often want the most highly trained researchers rather than the students who will benefit the most from the program”**

  – Workshop participant

**Preparing Interns**
The primary goal of many REU programs is to expose undergraduates to scholarly scientific research and to encourage them to consider careers in scientific research. Programs are often structured to help students gain the necessary experience and skill set to be admitted into and be successful in graduate school and start them on the path to become a professional scientists. Along these lines, workshop participants suggested several strategies related to preparing interns scientifically, including: having periodic or regular meetings with the student and at times their mentor, requiring status reports from students, having students present “elevator speeches,” and
holding workshops on preparing posters, written work, or talks. Some REUs reported that a weekly meeting to discuss issues in intern research and to provide support proved successful.

Professional development elements that some REUs use include: workshops on graduate school preparation, ethics seminars, code of conduct in email or at conferences, and providing students with support to travel to and present at conferences. Some reported that students found value in offering a GRE preparatory course.

The lack of specific skills by interns was raised as a challenge in that all students are not lacking in the same areas. Faculty members often have interest in students gaining knowledge in these gap areas, but prefer the REU program provide assistance. Topics that were commonly raised by workshop participants included the need for students to have improved statistics skills, programming, or writing skills. The REU leaders are encouraged to consider including training elements that are feasible and effective, such as workshops on statistics or writing, but to also keep an eye on the target of the productive research outcome.

3. Cohort Building & Tracking Past Participants

Plenary session 3 had two components with a focus on logistics of monitoring participation. Developing a strong student cohort was the focus of the “Cohort Building” component. “Tracking Past Participants” included a discussion on “Staying Connected with REU Alumni,” and is summarized here. The interest in these program elements was strong. Tracking past participants was the topic identified as being of greatest interest to REU leaders in the pre-workshop survey.

*Cohort Building*  
Developing interpersonal relationships within a student group is important, because cohesion promotes feelings of belonging, and the cohort provides a support system for the students during, and in some cases after, the REU. It was agreed that it is worth having team-building activities like a ropes course or an overnight field trip organized for the program outset, as developing those bonds early and quickly helps students to support each other throughout that program.

Ideas for building connections between students are many and diverse. They included: cooking together or having group meals, field trips with hiking or overnight stays, discussing papers together, doing a ropes course, participating in outreach activities, brown-bag lunches, designing a t-shirt together, providing bicycles, and giving students a list of activities in the area. It was suggested that having interns house with or near each other is key. One REU provided introductions between students rooming together before the program started. This allowed students the opportunity to get to know each other over Facebook first, which students reported was extremely useful.

Once students get to know one another, problems sometimes develop and may need to be addressed. Workshop participants shared examples including cliques forming, shy interns not participating, or students exhibiting immature behavior. REU leaders report that these are quite difficult to deal with and also need to be addressed on an individual basis.
Participants agreed that it is worth emphasizing to the interns that cohort-building is a critical part of the REU experience that enhances student success. Students with these bonds will support each other in challenging situations both during the REU and in years to come. Alumni report that the REU was a special experience and that the bonds formed with peers was a critical piece.

Fig. 8. REU leaders discussing how to facilitate cohort cohesion among interns.

Tracking Participants and Staying Connected with REU Alumni

Why track REU participants? Tracking participants allows us to follow student career paths, and to assess whether the REU program was helpful. Furthermore, funding agencies are interested in this information as a way of evaluating program impact. This sort of information, such as percent of REU participants who are in graduate school, is important to include in reports and proposals as evidence of the value and benefit of funding such programs. Asking questions of the alumni, such as “did the REU experience help you decide on graduate school either way, or on a career?” provides valuable information.

Workshop participants reported that methods of keeping track of students include having an email list (with an opt-out option), asking mentors and alumni about students, and searching with Google or Linked In. It was suggested that using Facebook to promote upcoming events, updates on events involving students, photos of students, and for locating students is effective. Tracking after the first year is easier due to interns presenting at meetings and conferences, although this is more challenging for interdisciplinary programs. Some REUs have developed university-style alumni tracking systems and web pages.

Questions were raised about which metrics are the most important to NSF. For example, is participation in the geoscience workforce considered a success, even if a student does not pursue a graduate degree? Other metrics that can be tracked in an alumni database include graduate degrees earned, publications, scientific meeting presentations, awards, and work experience.

Why stay connected with REU alumni? Reaching out to REU alumni not only helps with the tracking and overall program evaluation, but is highly valuable for the student. Such continued support and mentoring give students’ confidence which translates into success in their lives. Ways of reaching out to alumni include having get-togethers at meetings, texting, emailing, and calling them, involving mentors and alumni in networking with the students, and posting updates about students on Facebook.

4. Program Evaluation

The fourth plenary session focused on program evaluation, which was one of the top three topics of interest to respondents of the pre-workshop survey. Two speakers covered this topic, and breakout groups provided notes on their discussions. Concepts presented there are outlined below.

Why evaluate REUs? Research experiences are broadly accepted as critical components in the development of undergraduate STEM students. So, why continue to evaluate REU sites? REU sites need to be evaluated because they are programs designed to deliver research experiences to
students, rather than the programs being research experiences themselves. Thus the goal of the evaluation is to benchmark the performance of the program and to enable the program to improve over time. Data collected during the evaluation are used to shape decisions about program efficacy. Pre- and post-REU surveys can identify shifts in the students’ perceptions and affect, and which programmatic elements are working or need modification. For example, by finding out where students learn about a program, the REU can better target recruiting and communication efforts. REUs can use evaluative tools to help optimize a program, and provide feedback when an REU pushes boundaries by trying new things.

Evaluation can be used to help to keep a program on track. By identifying: (1) desired outcomes, (2) ways of measuring those outcomes, and (3) thresholds that are considered successful, one can design programmatic elements with the outcome in mind, and provide NSF with data to support the funding being provided. One example is provided below:

**Desired Outcome:** Program alumni will seek careers in the geosciences.

**Evaluation:** Long-term tracking of the education and careers of the intern alumni.

**Success metric:** 70% of alumni will attend graduate school in a geoscience or related field or pursue a geoscience career.

* * *

“When designing your evaluation, you should consider what you would like to be able to say about your program when it is up for renewal, and what data will be needed to support those claims. When things worked well, the data will support this position. When things didn’t work as planned, and this is okay to state when it happens, the data will provide justification for the changes in direction that you made to improve them.”

– Dr. Michael Hubenthal

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Finally, evaluations offer opportunities for researchers to use data collected during evaluations to generalize findings to populations rather than individual programs. This is especially the case when common assessment tools are used. Evaluation tools are available, such as the Undergraduate Research Student Self Assessment survey (URSSA), an instrument used for undergraduate research program administrators for program-level evaluation of student outcomes. This NSF-supported program is available for use at [www.salesite.org](http://www.salesite.org), and can be customized, and can have quantitative as well as written components. Examples of topics covered include gains in skills, changes in attitudes, graduate school and career activities, and demographics, amongst others.

5. How can we help each other?

*The Common Application*

The concept of a common application portal for REU programs was an area that generated much discussion. Prior to this workshop, a survey was distributed to RUE programs on the concept of a web portal with a common application. Dr. Eric Saltzman presented on the results of this survey, followed by general discussion and then breakout sessions.

The life cycle of the REU (application, decision, program, evaluation phases) requires staff time and effort which is multiplied over dozens of REU sites. On the student side, they have multiple applications that are nearly as rigorous as college applications, require the same information over
and over, and can be more numerous. Undergraduate professors report they feel they are drowning in REU recommendation requests from students.

A common application would require students to log in, enter standard information (name, email, etc.), upload transcripts, select REUs to apply to, respond to site-specific questions, list references, click submit, and track progress of the application online. The references listed could receive an email with a link to a login or portal, see a list of students requesting references, answer questions or upload a letter, and view or reuse previous recommendations. The REU staff or review committee would be able to log in and query information as needed with ranking and sorting options. REU programs would receive a notification when a student accepts another offer, and be able to collect needed information on students entering program.

In May of 2011, a survey on a possible common application was sent to all GEO REU PI’s and staff contacts. Twenty-six people from 23 REU sites responded. More than two-thirds of the respondents agreed or strongly agreed that there should be a central GEO REU web portal and common application, although most did not want the portal to be the only way students can apply. More than 75% of the respondents agreed or strongly agreed that there should be a common application deadline, that students should be required to rank REU sites in order of preferences, and that the system should automatically notify affected sites when a student accepts an offer of admission. Results from this survey are shown in Figure 9.

Fig. 9. Results from the GEO REU Portal Survey in which 26 respondents indicated their interest in and opinions on the details of a common online application (source: Saltzman, 2011 GEO REU PI Workshop).

The chart shown in Figure 10 indicates that most respondents expressed interest in using an REU web portal if it were available and in participating in the design of such a portal. At least some (9) of the respondents indicated that their institution might be interested in developing or operating such a portal.

Fig. 10. Interest in different aspects of using, designing, or operating an REU web portal (source: Saltzman, 2011 GEO REU PI Workshop).
Discussion amongst participants at the 2011 GEO REU Workshop focused on concerns about loss of REU Site control with the application process. After general discussion there was general interest in learning more about how a GEO REU application portal would work. Dr. Saltzman outlined five steps on moving forward on considering developing the GEO REU common application portal.

1. Decide whether to gather more information, and with the community’s input, decide whether or not to go ahead.
2. Create a task force to develop technical specifications for the portal.
3. Develop a proposal to create and operate the portal, or encourage NSF to solicit proposals.
4. Construct and test the system using volunteer REUs.
5. Roll out to the broader REU community.

Dr. Saltzman also identified several caveats related to the above process and general concerns that must be addressed.

- Privacy issues are a serious concern and will need to be addressed.
- Supplemental methods could and should be used.
- Use of the portal by REU site institutions need not be mandatory.

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“I really got the impression that the NSF or the organizers are trying to push for a common application and assessment tool. However, the diversity of REU programs and approaches is its strength.”

- Workshop participant.

“One of most effective aspects of the workshop was the discussion on common application (although it did not get as much support as I had hoped).”

- Workshop participant.

Ideas for the GEO REU Community

Discussions in breakout groups revealed great interest in having increased networking among REU sites. There was uniform agreement that communication itself is community building. There was also interest in having a GEO REU listserv, and simultaneous concern about there being too many emails as a result. An alternative idea of a blog was suggested, in which a blog site has partitions for different topical areas, with a reminder email sent when new material was provided. Support for using Facebook for REU networking was mixed to negative.

Without having a volunteer/community coordinator to take it on, it is difficult to make these endeavors succeed. It was reported that COSEE could serve as an advisor on this kind of effort. Working groups in COSEE communities (volunteer) address needs like these, and topical groups have been formed.

Another suggestion was to provide new site PIs with names of similar but more experienced site PIs to call for advice. There was general support for this approach. One benefit of verbal communication is that it is an informal mechanism and avoids concerns that are often raised with written communications.

Post-Workshop Survey Results

Fig. 11. Participants discussing ways in which the REU community can further work together.
The post-workshop electronic survey indicated that the workshop was well received by participants. All 50 responding participants rated the workshop excellent (86% of respondents) or good (12%) overall, and all respondents to the survey expressed interest in attending another such workshop if offered in the next year or two (Figure 12). Of the plenary sessions, “Organizing the REU community” received the greatest number of positive scores from survey respondents (40% found it “extremely valuable” and 50% found it “quite valuable”). “Creating inclusive REUs” received 85% “extremely valuable” or “quite valuable” ratings. The plenary sessions on program structuring, cohort building/tracking alumni, and program evaluation were all rated as “extremely valuable” or “quite valuable” by 80% of post-workshop survey respondents. Only the session on common applications received any scores in the “not valuable” category (8% of respondents).

Fig. 12. Percent of respondents who rated each component of the workshop as extremely valuable, quite valuable, etc., with n=50.

Opportunities for networking and discussion with personnel from other REU sites were viewed as even more valuable than the plenary talks. A third of respondents stated they would have found that having more time for discussion would have been valuable. Respondents were most enthusiastic about opportunities for discussion within their division; 96% found these discussions “extremely valuable” or “quite valuable.” The exchange of ideas during roundtable discussions, with participants from other divisions, and at the poster session were valued highly (86%, 80%, and 79% of ratings were “extremely valuable” or “quite valuable” respective.

In terms of moving forward from the workshop, Division-based breakout groups discussed various ways in which the REU community might work together (Fig 13.). Based on these discussions and on responses to the post-workshop survey, participants were most interested in future community collaboration via a listserv for information sharing and advice (favored by 89% of respondents), REU gatherings at major conferences such as AGU, AMS, and GSA (87%), and a GEO REU webpage (75%). Forty percent of survey respondents were interested in participating in local or regional support groups; less than a third of respondents expressed interest in topical support groups or a GEO REU Facebook group. About half of all respondents indicated interest in a leadership committee to organize the REU community and move forward.
Forty-three of the 50 respondents indicated that they had participated in the SACNAS conference that immediately followed the GEO REU Workshop, 72% of whom said that they agreed or strongly agreed that attending was a valuable experience for them. Of those, 32 attended the opening ceremonies or keynote speech, and 22 participated in the “Conversations with Scientists,” a function designed to introduce students to professionals. Several respondents to the post-workshop survey listed the co-location of this meeting with SACNAS and the connection to the SACNAS conference as one of the three most effective aspects of the GEO REU workshop (see Figures 14 and 15).

Fig. 14. The number of people from the REU workshop who attended or visited the following events or venues.
The post workshop survey asked whether participants had suggestions on the length or format of the workshop. In other comments on the workshop, people liked the format of the workshop very much. A few respondents said that the conference was just the right length, however, there was a general consensus amongst responding participants that the workshop was too short and did not allow enough time for informal discussions.

* * *

“The SHORT "lecture" sections followed by breakouts for in-depth discussion; networking with other REU PIs to gain perspectives and experience; * the focus of the sessions [e.g., not too broad; not too narrow]”

- Workshop participant.

“Length was way too short. It was a long way to travel for such a short time. And, the agenda was so jam-packed, it was hard to take a few minutes and make sure I was getting everything I wanted out of it. For example, there was no time to go around and look at what all the discussion groups had come up with -- all I knew was what was covered in my group. I think the fast-paced schedule has its advantages (e.g., forces quick, incisive discussions), but adding just half a day would allow for more time to just talk to other people -- I would have liked another poster session on the 2nd day, once I had a better idea of who was who, and who I should talk to.”

- Workshop participant.

* * *

One of the reasons that the workshop was planned to have this short length of 1.5 days was to give people time to attend and participate in the SACNAS conference. More than 75% of the survey respondents attended a SACNAS event, and over 80% of respondents said that they would attend SACNAS again. Another respondent had a suggestion that would allow for more time in an REU meeting simply by changing the schedule:

* * *

“I think the length is fine, but would recommend a slight shift in the schedule. I would recommend starting first thing in a morning. This way people could get in on flights after completing a work day or most of a work day. Then have a full day of the workshop followed by a morning session on the next day. This will allow for the same total amount of meeting time and perhaps more, but result in less time away for folks...”

- Workshop participant
“I thought that the REU workshop was essential. I benefitted tremendously from the sharing and the exchange I had with my colleagues. The workshop experiences and interactions have helped to enhance the execution of my PI duties and my overall REU program.”

- Workshop participant

This was a pilot workshop, and the feedback from the post-workshop survey suggests that there is a strong need and desire to have similar future workshops, and to increase the workshop time from 1.5 days to 2 days in length.

**Concluding Recommendations**

This workshop provided a unique opportunity for REU leaders to come together and discuss challenges identified before the meeting as important to community members, as well as to gain support from each other through sharing experiences and strategies. The overall workshop feedback indicates it was perceived as much needed and highly valuable. There were requests to hold a similar meeting every other year.

Participants developed six recommendations for the REU community and sponsors, which are presented roughly in order of priority. These recommendations summarize the suggestions presented to the whole group in the concluding remarks by the Division representatives, and were supported in the responses of the post-workshop survey.

1. To create a communication mechanism, such as an REU listserv, for the purposes of building community, planning events, sharing information, and developing collaborations amongst REU site PIs and staff.
2. To organize REU gatherings at the major conferences representing each NSF Division.
3. To develop a leadership committee that would help to organize the REU community and take leadership on relevant issues, including plans for communication and networking.
4. To consider creating a webpage for REU PIs and students, including a plan for website updating and maintenance.
5. To hold a biannual meeting for REU PIs, if possible.
6. To assign the leadership committee with the task of providing the community with more information on the REU web application portal (common application) and follow up with action items.

It should be noted that at the time of this report, two recommendations have been acted on:

1. A listserv for the community has been established and used effectively for sharing information, requesting information for NSF, and discussing challenging issues.
2. REU gatherings have been organized and held at the following meetings: AGU 2011, AMS 2012, and ASLO 2012. Informal REU gatherings are being planned for upcoming conferences in 2012 and 2013.

A teleconference for REU leaders on the topic of mentoring (and mentoring mentors) was held in June 2012, hosted by Valerie Sloan at UNAVCO. Other community members have agreed to take on a leadership role of the listserv and planning of conference gatherings. These activities were well received and have potential to continue successfully.
The next step forward in furthering REU community development is to formalize a leadership committee, including recruiting volunteer members and a chair. This group could meet by telephone quarterly and discuss topics such as developing a website for REU sites and students, to look into planning a 2\textsuperscript{nd} GEO REU Workshop for 2013 or 2014, and organizing the dissemination of information on an REU web portal with a common application and discussions on that topic. This leadership committee could serve as the collective liaison between REU PIs and NSF and focus their initial efforts on discussing funding possibilities for the workshop, website, and portal. The National Science Foundation could support the leadership committee through providing resources such as a teleconference system and funds for meeting in person at a large conference.

**Action Item:** The strategic planning committee for this workshop will work with NSF to establish a GEO REU Leadership Committee by February 1, 2013, and put forward the recommendations outlined above to that committee for consideration.

It is thanks to the National Science Foundation that these REU programs exist, and that we were able to gather and launch the first event of the GEO REU community, and for this we are grateful. We look forward to executing some of the recommendations made at this workshop in collaboration with the NSF, and with each other.
References


## Appendix A: Workshop Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Abbott, Dallas</td>
<td>Lamont-Doherty Earth Obs of Columbia Univ.</td>
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<tr>
<td>Aguilar, Carmen</td>
<td>Univ. Wisconsin-Milwaukee</td>
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<td>Anderson, Diana</td>
<td>National Science Foundation</td>
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<td>Arratia, Juan</td>
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<td>Cox, Tara</td>
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<td>Cuhel, Russell</td>
<td>Univ. Wisconsin-Milwaukee Center for Great Lakes Studies</td>
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<td>Garza, Corey</td>
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<td>Johnson, Leon</td>
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<td>Korreck, Kelly</td>
<td>Smithsonian Astrophysical Observatory</td>
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</tbody>
</table>
LaDue, Daphne  
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Wiu, Meiying  
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Woods Hole Oceanographic Institution
## Appendix B: Workshop Agenda

### Workshop Agenda

**Wednesday - October 26**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
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| 3:00 pm - 4:00 pm | Pre-Poster Session & Workshop Registration .................................................... South Tower Foyer  
This pre-poster session will be informal due to varying arrival times of workshop participants. |
| 4:00 pm - 5:30 pm | Welcome to the Workshop - Val Sloan, UNAVCO ...................................................... South Tower Foyer  
Poster Session - Start making connections with other REU leaders to share ideas, effective practices, and think about collaborating in small ways. Posters will be left up for the duration of the workshop. |
| 5:30 pm - 6:15 pm | Dinner .......................................................................................................................... Sacramento Room |
| 6:15 pm - 7:00 pm | Keynote Speaker - Raj Pandya of SOARS & UCAR  
“Launching Tomorrow’s Citizen-Geoscientists” (~30 min talk, 15 min discussion). |
| 7:15 pm - 7:45 pm | Session 1: How to Create Inclusive REUs ........................................................................ Gold Room  
Speaker 1: Fostering partnerships to increase diversity (10 min talk, 5 min discussion)  
Ashanti Johnson/Allyson Fauver from IBP  
Speaker 2: Including diverse applicants in your REU - Diana Dalbotten  
University of Minnesota |
| 7:45 pm - 8:45 pm | Breakout discussions by Division ................................................................................ Gold/Piedmont/Hillsborough Rooms |
| 8:45 pm         | Carry on informal conversations and poster viewing ................................................. South Tower Foyer |
Workshop Agenda

Thursday - October 27

7:00 am - 8:00 am  Breakfast · Round Table Discussions ................................................................. Sacramento Room

8:00 am - 8:45 am  Session 2: Structuring an REU program, Mentoring, and Preparing Interns .... Gold Room
Speaker 1: Structuring and REU Program, Linda Schaffner, VIMS/W & M
Speaker 2: Mentoring - Russell Cuhel, UW Milwaukee
Speaker 3: Professional development for interns, David Mogk, Montana State U.

8:45 am - 9:30 am  Small working group discussions on Session 2 topic ........................................... Gold Room
 (~ 6 people/cluster, grouped by organizers)

9:30 am - 9:45 am  Reporting ................................................................................................................. Gold Room
I. Small groups reps. report main points on sticky notes for the wall/ Google Docs
II. Individuals reflect on and write down:
   1. One thing that you will do in your program (extra pages at back of program).
   2. Who you could call on from this group for support on this.

9:45 am - 10:00 am  Break ...................................................................................................................... South Tower Foyer

9:45 am - 10:00 am  Gallery Walk to view sticky note ideas that have been posted .............................. Gold Room

10:00 am - 10:30 am  Session 3: Cohort Building & Tracking Past Participants ............................ Gold Room
Speaker 1: Building a strong REU cohort, Daphne LaDue, U. Oklahoma
Speaker 2: Staying connected with and tracking REU alumni, Frederika Moser, U. Maryland

10:30 am - 11:20 am  Small working group discussions on Session 3 topic ........................................... Gold Room
 (~ 6 people/cluster)

11:20 am - 11:30 am  Reporting ............................................................................................................. Gold Room
I. Small groups reps report main points on sticky notes for the wall/Google Docs
II. Individuals reflect on and write down:
   1. One thing that you will do in your program
   2. Who you will call on from this group for support on this.

11:30 am - 12:30 pm  Lunch · Round Table Discussions ................................................................. Sacramento Room

12:30 pm - 1:00 pm  Guest Speakers: Introducing the SACNAS Community and Meeting ........ Sacramento Room
Speaker 1: Corey Garza, CSU Monterey Bay
Speaker 2: Aaron Velasco, UTEP

1:00 pm - 1:45 pm  Session 4: Program Evaluation ............................................................. Gold Room
Speaker 1: Evaluation: shaping students’ experiences in IRIS’s REU Program
Michael Hubenthal, IRIS
Speaker 2: Program evaluation: one approach, Alan Christian, U. Mass Boston
Discussion time
Workshop Agenda

Thursday - October 27

1:45 pm - 2:30 pm  Session 5: How can we help each other? - Our REU community
Breakout discussions by Division............................................ Gold/Piedmont/Hillsborough Rooms
Ideas might include:
• Hold REU gatherings (e.g. an evening event) at big conferences (e.g. AGU, AMS, etc.)
• Create a listserv (for questions, problem solving, information sharing, and advice)
• Use Facebook Group (GEO REU) for group postings
• Create a small committee to organize & move forward
• Develop & contribute to a web page (see the BIO REU Webpage as an example)
• Hold an annual or biannual REU Workshop
• Create local/regional/discipline-based group for support
• Find a few local partners or topical partners who you can talk to regularly.

2:30 pm - 2:45 pm  Break ......................................................................................................................... South Tower Foyer

2:45 pm - 3:15 pm  Session 5 continued: How can we help each other? ................................. Gold Room
Speaker 1: Results of the survey on common applications, Eric Saltzman, UC Irvine
Speaker 2: Benefits of organizing an REU community & How to do it, Diana Anderson, NAU

3:15 pm - 4:00 pm  The Division Representatives will present summarized goals and objectives ...... Gold Room
What are our action items for going forward to help REU leaders? (Let’s make a list)
Close of the REU Workshop and transition to the SACNAS Meeting.

Beginning of the SACNAS Meeting
Please refer to the SACNAS Agenda for rooms

4:00 pm - 6:30 pm  SACNAS Opening Ceremony

8:15 pm - 9:45 pm  “Conversation with Scientists” Event at SACNAS Meeting
Professionals (that’s us) gather with students to engage in informal round-table discussions about careers in the physical sciences. Choose a room: (1) atmospheric sciences/meteorology, (2) Earth science, (3) oceanography, (4) other geological sciences. The personal connections made here set the stage for ongoing mentorship & support throughout the conference, and beyond. You tell them about your program, they ask for advice, and more. **Highly recommended!!!**
Appendix C: Talks

Pandya, Rajul: Launching Tomorrow's Citizen-Geoscientists, Keynote Speaker, UCAR
Johnson, Ashanti: Fostering partnerships to increase diversity
Dalbotten, Diana: Including diverse applicants in your REU
Schaffner, Linda: Structuring and REU Program
Cuhel, Russell: Mentoring
Mogk, David: Professional development for interns
LaDue, Daphne: Building a strong REU cohort
Moser, Frederika: Staying connected with and tracking REU alumni, Assistant Director for Research, Maryland Sea Grant College, University System of Maryland
Hubenthal, Michael: Evaluation: shaping students' experiences in IRIS's REU Program
Christian, Alan: Program evaluation: one approach, University of Massachusetts, Dept. Biology
Saltzman, Eric: Results of the survey on common applications, Univ. California at Irvine, Department of Earth System Science
Anderson, Diana: Benefits of organizing an REU community & How to do it, Program Director, National Science Foundation

Posters - Listed by Workshop Participant

Abbott, Dallas. Research Focusing Sessions: A Method to Improve Student Understanding and Scientific Quality of Research
Arriata, Juan. Research Experience for Undergraduates at the Arecibo Observatory
Bailey, Jake. Summer REU at the U: Fluids in the Earth, from Surface to Core
Blake, Reginald. Research Experience for Undergraduates in Satellite and Ground-Based Remote Sensing at NOAA-CREST
Boehlert, George. From OCE-REU Interns to Research Mentors: 2010 REUnion An event focused on the NSF-supported Ocean Sciences REU programs at the 2010 Ocean Sciences Meeting
Boehlert, George. Oregon Marine Science REU Site: From Estuaries to the Deep Sea Developing a Culture of Undergraduate Research in the Marine Sciences
Braile, Lawrence. SAGE - Summer of Applied Geophysical Experience Learning Geophysics by Doing Geophysics for 29 Years
Carroll, Mary Anne. Developing a Culture of Undergraduate Research in the Marine Sciences.
Chandra, V.Chandrasekar. Research Experience with the CSU-CHILL National Radar Facility: A unique inter disciplinary experience in Science and Engineering
Chowdhury, Shafiul. Modeling the glacial history of the Ashokan watershed in the Catskill Mountains of New York using
Chowdhury, Shafiul. The hydrogeology of a highly unstable streambank affecting the New York City’s drinking water supply.
Colonial, Yamilette. An Overview of NSF Geosciences Research Experience for Undergraduate Site Programs from 2009 through 2011
Cox, Tara. Bridge to Research: An Early Research Experience in Marine Science
Cuhel, Russell. From The Very Beginning: Freshwater-Based Ocean Science REU Recruits for Aquatic Science at the UW-Milwaukee Center for Great Lakes Studies Over 23 Sessions!
Dalbotten, Diana. The REU on Sustainable Land and Water Resources--Experiences from our First Summer On the Rez.
Dellapenna, Timothy. Marine Science and Marine Biology of the Gulf of Mexico and other Coastal Oceans: TAMUG NSF REU Site Summer Internship Program.
Dawson, Matt. GeoCorps America - Paid, short-term geoscience positions on America’s amazing public land
Dittel, Ana. Marine Sciences Summer Intern Program at the University of Delaware: An Overview
Dontsova, Katerina. REU Site: Environmental and Earth Systems Research at Biosphere 2
Fauver, Allyson. Pathways to Ocean Sciences: Broadening Participation in Summer Research for Undergraduate Programs.
Fleming, Claire. A Summer in the Clouds and Other Educational Opportunities at CMMAP.
Haacker-Santos, Rebecca. Student success and career choices - Tool for longitudinal participant tracking and evaluating program impact.
Houser, Chris. Implementing a new REU in Costa Rica
Huang, Tian-Sen. REU Program at Prairie View Solar Observatory
Johnson, Leon. The City University of New York/NASA Goddard Institute for Space Studies Center for Global Climate Research - NSF REU
Jones, Alice. Lessons in Collaboration & Field Research Design from the Appalachian Headwaters: Research Experience for Undergraduates
Jones, Alice. Research Experiences for Teachers: Coal Mining’s Impacts on Soil Carbon Storage and Erosion in Appalachian Headwater Streams
Judge, Jasmeet. NSF-REU Site for Integrated Research and Extension in Water Resources at the University of Florida.
Kelley, Patricia. REU in Biodiversity Conservation: a multidisciplinary, collaborative approach to undergraduate research
Kingsley-Smith, Peter. Minorities in Marine and Environmental Sciences (MIMES) Program: a 12-week undergraduate research internship at the Marine Resources Division.
Kirkpatrick, Barbara. An Evaluation Process to Assess Students’ Interpersonal Skills and Career
Outlooks in an REU Program.
LaDue, Daphne. Highlights of the NWC REU Program
McKenzie, David. REU Site for Solar Physics at Montana State University
Moser, Fredrika. Taking steps to improve participation by underrepresented groups in a REU estuarine sciences program.
Moser, Fredrika. Maryland Sea Grant research experiences for undergraduates: Twenty-two years of marine science training for undergraduates
Plumley, F. Gerald (Gerry). NSF-REU at the Bermuda Institute of Ocean Sciences
Pullin, Michael. Interdisciplinary Science for the Environment: A Summer REU Program at New Mexico Tech.
Schnaffner, Linda. REU Site Program: Coastal Marine Science at the Virginia Institute of Marine Science.
Smith, David. 25 Years of the SURFO REU at Program at GSO/URI: Summer Undergraduate Research Fellowship in Oceanography
Snow, Martin. The REU in Solar and Space Physics at the University of Colorado
Suddarth, Steve. A University of New Mexico REU Project: LEISA: Low-Earth Orbit Spectrum Analyzer
Verner, Ekaterina. The Scientific and Engineering Student Internship (SESI) Program at NASAs GSFC.