

**Best Practices
in International
Research
Experiences for
Graduate
Students**



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This workshop was supported by NSF award # [1840364](#).

Recommended Citation: Mitchell, B.S., *et al.*, Final Report: Best Practices in International Research Experiences for Graduate Student, 2019. Retrieved from <http://nsfworkshop.wp.tulane.edu/wp-content/uploads/sites/378/2019/04/NSF-2019-Workshop-on-International-Research-Experiences-Final-Report.pdf>

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Executive Summary

In order to provide information to the higher education community on the effective development of global research competencies in the STEM research workforce, an NSF-funded workshop (OISE1840364) was held in Alexandria, VA on January 10-11, 2019 entitled “Best Practices in International Research Experiences for Graduate Students.” Workshop activities were structured to gather information on three fundamental questions related to international research experiences for students enrolled in U.S. graduate schools:

- What are the appropriate timing and duration for introductory, follow-on, and subsequent international research experiences during a STEM PhD student’s training? What about a STEM master’s student?
- What is the appropriate role of the student’s faculty research advisor (aka PI, research mentor) in identifying, defining, permitting, and evaluating the advisee’s international research activity?
- What are the appropriate entities for assessing the international research activity experiences, defining the appropriate assessment tools, collecting and archiving data, and conducting longitudinal studies on international research experiences?

The workshop was attended by over forty experts in the area of international academic activities and included presentations, discussion sessions, and a report-out of a pre-workshop survey. These inputs were used to generate the following set of best practices that serve as the report recommendations:

- In considering the timing and duration of a graduate student’s research visit, an **evaluation of their interpersonal and cognitive skills development** should be undertaken in order to determine their readiness for the experience.
- The intended outcomes, skills development, and competencies of an international research experience should be enumerated and a corresponding **evaluation plan** with both formative and summative components developed prior to the research visit.
- A **decision-tree approach** should be used to assist students in determining the optimal timing and duration in order to account for the numerous factors that contribute to these important structural components of an international research visit.
- As with all facets of a positive advisor-advisee relationship, a **graduate student’s research advisor should serve as an advocate** for their advisee’s international research experience. This includes assessing their readiness, articulating expected outcomes, and facilitating an appropriate international activity to the best of their ability.
- Institutions should provide **training for research mentors** on how best to facilitate international research experiences for their graduate students that leverages institutional expertise on such logistical issues as health and safety abroad, deemed export control, immigration status of participants, and the responsible conduct of research in an international setting. Funding agencies could provide grants directly to the institutions, consortia, or regional/national hubs for this research mentor training.
- Programs that sponsor international research activities for graduate students should **collect, update, and make freely and easily accessible to current and prospective graduate students** information about outcomes of the activity that is collected in a standard format, is fully transparent, and can be easily accessible and transferable across multiple computer and statistical analysis platforms.

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Introduction

The training of the scientific research workforce in the United States has always involved international considerations. From the recruitment of international students into its graduate education programs to international research collaborations of the largest scale, U.S. institutions of higher education have sought to bring science and scholarship to the fore irrespective of who is doing the work or where it is being done. As the conversations on internationalization in higher education and preparation of a global workforce evolve – complicated by seemingly ever-changing considerations of privacy and national security – institutions, funding agencies, and individuals continue to seek ways to enhance scientific training in a global context. For example, an appreciation for how research is conducted in a global context is important not only for the development of professional skills, but for the quality of the research as well. Despite the established need for the development of global competencies in STEM education [1,2] and numerous opportunities that graduate students have for international research experiences through international, federal, state, and local organizations, little is known about how such funding opportunities and activities should best be structured to maximize their impact, and even what that impact is on their career development.

A workshop funded by the National Science Foundation (OISE1840364) was held in Alexandria, VA on January 10-11, 2019 entitled “Best Practices in International Research Experiences for Graduate Students” in order to gather information on three fundamental questions related to international research experiences for students enrolled in U.S. graduate schools (see Appendix I for the full agenda):

- ***What are the appropriate timing and duration for introductory, follow-on, and subsequent international research experiences during a STEM PhD student’s training? What about a STEM master’s student?***
- ***What is the appropriate role of the student’s faculty research advisor (aka PI, research mentor) in identifying, defining, permitting, and evaluating the advisee’s international research activity?***
- ***What are the appropriate entities for assessing the international research activity experiences, defining the appropriate assessment tools, collecting and archiving data, and conducting longitudinal studies on international research experiences?***

The workshop was attended by over forty experts in the area of international academic activities (See Appendix II for the full list of participants) from across the U.S., including faculty who run such programs, former participants, university administrators, and members of organizations involved in graduate education and/or international activities. As the workshop occurred during the partial government shutdown of 2018-19, there were no attendees from the impacted federal agencies, including NSF.

The three primary questions were formulated with a target audience of students enrolled in STEM graduate programs at U.S. institutions of higher education in mind, regardless of whether or not they themselves are international students. Although it is true that participation in some NSF-funded international programs is often limited to U.S. citizens or permanent residents, the Advisory Committee felt that the questions were general enough that findings could apply to both international and domestic graduate students in the U.S. As to whether the findings will be more broadly extensible to institutions,

agencies, and programs outside the U.S., the Advisory Committee recognized that graduate education (often called postgraduate education) outside the United States can be fundamentally different and that such related topics as global competencies and researcher mobility must be viewed in the context of economic and geopolitical climates. With these caveats in mind, the information gleaned from this workshop is intended for use by government agencies, graduate schools, faculty who mentor graduate students, potential and current students, international offices and officers, and even undergraduate study abroad programs who advise students on preparing for advanced degrees or scientific careers to help them with program implementation and improvement and with data collection that feeds into formative and summative evaluation activities.

For the purposes of this workshop, an international research experience was broadly defined as any research-related activity undertaken by a graduate student while enrolled in a U.S. institution of higher education in which they travel outside the U.S. either individually or in groups. These experiences are distinctly different from undergraduate credit-bearing activities – commonly known as study abroad – and international activities that do not have an academic or research component such as cultural exchanges. These distinctions are undoubtedly imprecise. For example, the presentation of research results at an international conference is not only research-related and skill building, but can involve the development of intercultural competencies, even if at the introductory level. Nevertheless, the primary type of international activity considered at this workshop generally was one that lasted at least one week and involved exposure to how research is conducted in an international context as a key component of the experience.

The workshop built upon two previous workshops on related topics. The first (NSF grant #105029, PIs Maresi Nerad and Tami Blumenfield) occurred in 2011 and was devoted to evaluating the international research experiences for graduate students. The resulting [report](#) from that workshop [3] outlined the following key research questions:

1. Does international collaboration lead to better science/scientists?
2. Do current institutional and funding structures lead to missed opportunities for international collaboration? If so, how?
3. How can we assess institutional preparedness for international collaborations/ experiences?
4. What are the expected outcomes and goals of international experiences/collaborations? How are they established?
5. What are the actual impacts, outcomes, and transformation of the international experiences/collaborations?

Despite this initial effort, many of these key research questions remain unanswered. In particular, the research questions related to outcomes and assessment were the focus of a follow-up workshop. The second workshop took place in 2016, and was organized by the Council of Graduate Schools (CGS), the Division of Graduate Education (DGE) and the Office of International Science and Engineering (OISE) at NSF, and the Washington Office of the Deutsche Forschungsgemeinschaft (German Research Foundation, DFG). This workshop focused on the specific topic of evaluating international research experiences for graduate students. In its [report](#) [4], the workshop Advisory Committee formulated a set of recommendations to stakeholders on how to evaluate the impact of these experiences, including

long-term career tracking of participants. As with the first workshop, many of these questions remain and the degree to which recommendations have been implemented varies greatly.

A more focused approach was taken with the current and third workshop. The three key research questions were posed as listed above, with the intent of providing concrete feedback to NSF on how best to structure the international research components of their funding programs. With this goal in mind, workshop activities were arranged in such a way that brief presentations by experts in the field were followed by intensive discussion sessions by workshop participants on the primary research topic and related questions. The outcomes of these discussions were recorded and serve as one of the primary sources of input to this report. The other sources of input for this report include existing literature (including the previous workshop reports), a pre-workshop survey, and follow-on discussions with key contributors to the workshop.

Workshop Outcomes

There were several over-arching findings that are relevant to all of the research themes. The first finding was simply recognizing that there are many ways in which graduate students participate in international research activities. Some are highly structured, some are not. Some involve cohorts, some do not. Those participation models should be defined before a conversation on relative merits takes place. The second general finding is that it is difficult to adequately represent the alternative position on international research experiences, namely, that that they do not provide the benefits they are purported to provide or that even if they do, the costs – be they financial, time, or lost productivity – outweigh those benefits. The Advisory Committee attempted to provide a balanced view of international research activities primarily through a pre-workshop survey distributed to faculty at selected institutions. The results of that survey are summarized in a following section. Outcomes from the three research themes are then presented with best practices interspersed as key workshop recommendations.

Participant Model

It was clear from the break-out session discussions that best practices are highly dependent upon how the international research opportunities are structured and offered to participants. There are three broad categories of participation by graduate students: as individuals, as part of a cohort, and as part of a hybrid model.

Individual Experience

Individual graduate students can and do formulate their own international research experiences through institutional support, independent funding organizations, and even through self-funding. An example of this activity is graduate students who perform research visits with funding through the [Fulbright Program](#), [DAAD RISE Professional program](#), or through large U.S. federal grants to institutions such as research centers that provide funds to support individual international activities. Even though there may be conferences and workshops for all students and even alumni/ae of the program, the opportunity is identified by, applied for, and undertaken by the individual.

Cohort Experience

The cohort model best describes how the majority of NSF-funded international research programs are structured. A group of investigators at one or more institutions develop international activities for their students around common research themes. Cohorts can be large or small. The distinguishing features of the cohort model are that participants apply to the program organizers rather than the funding agency, and they perform some or all of their international activity as a group. Common experiences can include pre-departure training and evaluation, educational and cultural experiences as a group during the visit, or post-visit evaluation and follow-up with the entire cohort. Examples of programs that utilize the cohort model are the [IGERT Global Traineeship in Sustainable Electronics at Purdue University](#) or the [CuBISM PIRE program at Northwestern University](#).

Hybrid Experience

In the hybrid model students may be part of a formalized international research activity that both organizes the research activity and tracks student participants, but their experience is highly individualized. They take part in the activity on their own, even if they are part of a collaborative research team either at home, abroad, or both. An example of this activity is an institutional-based exchange agreement in which a memorandum of understanding or similar document establishes the reciprocity parameters for bi-directional exchange, but the students perform their international research experiences at various times and primarily as individuals.

There is considerable overlap between these models and there is no evidence that one is more effective than the other. For the purposes of this workshop, the cohort model was the basis for most discussions as this is the primary model utilized by NSF, but distinctions are drawn and other models discussed as appropriate.

Pre-Workshop Survey

New to this third workshop was a pre-workshop survey that was developed by the Advisory Committee, approved by the Purdue University Institutional Review Board (IRB) and distributed to all registered attendees approximately two months prior to the workshop using Qualtrics (see Appendix III for a list of questions). Recipients were encouraged to not only complete the survey themselves, but to forward it to their colleagues and networks. The survey was also distributed to the American Physical Society list serve by its staff. A total of 101 verified responses from individuals who self-identified as faculty members were received. The results of this survey are not generally statistically significant and were used only to help frame conversations for the breakout sessions and to provide qualitative framing for some of the post-workshop analysis.

For example, prior to the breakout session on timing and duration, workshop participants were told that the majority of survey respondents felt that an international research experience of four months or less was most appropriate, and that a majority of respondents felt that for doctoral students the international experience was best conducted after comprehensive/qualifying exams, but before the preliminary/prospectus examination. Similarly, prior to the discussion of Theme 2 on the role of the research advisor, workshop participants were told that survey respondents were only marginally positive on the value of an international research experience, even though nearly three-quarters of the faculty respondents had some international experience. Finally, with respect to data collection,

approximately half of the respondents felt that it was the responsibility of the home institution to collect information on graduate student international research experiences.

Since the workshop end, an additional 46 survey responses have been collected. The workshop Advisory Board intends to continue with more detailed analysis of the survey results and even further distribution, and will publish an addendum to this report when that analysis is complete.

Theme 1: Activity Timing and Duration

What are the appropriate timing and duration for introductory, follow-on, and subsequent international research experiences during a STEM PhD student's training? What about a STEM master's student?

Priorities

The timing and duration of an international research stay should be driven by the intended outcomes. Those outcomes manifest themselves as stakeholder priorities at many levels: national, institutional, and individual. Priorities at the national level include generating new knowledge, developing a strong technical workforce, and building research capacity in host countries. Institutional priorities include fostering interdisciplinarity, enhancing faculty engagement, supporting community outreach, and shifting institutional culture. There may be other regional and institution-specific priorities as well. The focus here, however, is on the priorities related to the individuals: the research advisor and the student participant. The priorities for the research advisor are discussed in the following theme in the context of providing student support. In this section we describe the priorities for students that directly influence the timing and duration of the international research activity.

The priorities students have in considering an international research experience are many and varied. Some are purposeful and intentional; some are not. The workshop generated many ideas for student outcomes of an international research experience, some of which are listed in no particular order in Table I. Note that in some research intercultural competencies and/or global preparedness have included several of these bullets as attributes that define them (e.g., adaptability, understanding cultural variations, and communication skills). These student-level outcomes can be evaluated and assessed (see the report from the 2016 Workshop) using existing methods. In fact, these are the outcomes of a logic model that should be developed as part of an international educational experience. Most of these outcomes require both pre- and post- visit reflective instruments - that is, students will not have seen the value until several months or years after their international research experience to see how it impacted their research and/or career paths as well as their outcomes. Other approaches will require targeted interview protocols.

Table I Examples of student outcomes from international research experiences.

- Personal development
- Adaptability and resilience
- Global preparedness
- Critical thinking
- Network and collaboration
- Intercultural competencies
- Communication skills
- Understanding of cultural variations to research
- Trust-building/empathy with local entities

They can also be categorized in order to better determine which type of graduate-level skills they address. A discussion of graduate-level pedagogy is beyond the scope of this workshop, but for the sake of simplicity the domain-level approach utilized by the National Research Council [5] is adopted here. The key skills students at any level must learn fall into three broad categories: cognitive skills; interpersonal skills; and intrapersonal skills*. When viewed as competencies, the outcomes listed in Table I and others like them can fall into more than one of these skills categories. The outcomes that are in many ways unique to the international research experience such as developing an appreciation for cultural variations to research and global preparedness fall distinctly in the realm of intrapersonal skills development. In fact, the appreciation of how research is conducted in an international context was the most-cited benefit to students conducting international research visits by the workshop participants. The participants felt strongly, however, that pre-departure evaluation of both the student's preparedness to go abroad and their targeted skills development categories were necessary in order to properly structure the visit. Intercultural assessment paradigm is shifting away from the exclusive use of pre/post tools since global competence development is a lifelong process, and more towards formative assessment that provides feedback to students on their achievement of the stated outcomes. The strong consensus on these two skills-building topics leads to the first two Best Practices findings of the workshop:

Best Practice 1: In considering the timing and duration of a graduate student's research visit, an evaluation of their interpersonal and cognitive skills development should be undertaken in order to determine their readiness for the experience.

Best Practice 2: The intended outcomes, skills development, and competencies of an international research experience should be enumerated and a corresponding evaluation plan with both formative and summative components developed prior to the research visit.

These best practices should be employed when formulating any international research program, independent of the model (individual vs. cohort), funding level, timing, or duration. Timing and duration are the specific topics of the following sections.

Timing

A key consideration in the timing of a research visit is the student's preparedness. Preparedness certainly includes current levels of technical competency and emotional maturity, but as one workshop participant put it, the student must exhibit a "commitment to the field" in order to be fully prepared for an extended international research experience. That preparedness can come early or late in their graduate studies. Some students may simply not be ready to reap the full benefits of their research experience abroad. Others may be better prepared later but then may be near enough to degree completion that an extended research stay is contraindicated. There were no clear recommendations on how that preparedness should be evaluated. Some tools exist for evaluating global preparedness and are listed at the end of this section. Other factors affecting the timing of a research visit include whether the student is part of a cohort or is going on their own, whether appropriate bi-national

* Other models of skills development include [Researcher Skill Development](#) and discipline-specific signature pedagogies [6].

agreements are in place for programs with reciprocity (such as the NSF-funded GROW program), and whether the student is visiting a high-resource or low-research country.

Degree level also impacts timing. For master's level students the windows of opportunity are much narrower simply because of the shortened program length. Compounding the difficulty of timing for master's students is the course load requirements for the degree, even for the so-called research master's degrees. These factors limit the opportunities to two basic types at the master's level: a highly structured international activity during an academic term as part of required coursework; or an activity during the summer between the first and (presumably final) second academic year. The workshop did not focus on the relative merits of these two approaches. At the doctoral level, there is more flexibility in the timing of the international activity. Assuming best practices in the evaluation of a student's readiness for an international activity have been followed, the workshop participants generally felt that sometime in the second or third year of a PhD student's tenure is optimal for an extended research stay. There was also the suggestion that a bridge project could occur toward the end of the PhD to help a student transition from graduate school to an international postdoctoral experience.

Duration

The duration of the international research experience has even more influencing factors. In addition to student preparedness and the type of international program (cohort vs. individual) that affect the timing of the visit, duration is impacted by funding and the level of host financial support, the number and duration of previous research visits, language considerations, and advisor desires (see Theme 2). A scaffolding model may be beneficial for some students in which brief introductory visits (1-2 weeks) are used to lay the foundation for longer subsequent visits. Short-duration experiences can be used for observational visits or to gain insight into a new culture or research opportunity, whereas repeat or longer-duration visits can be used for specific research or technology development projects.

Not to be overlooked are family considerations. Here, the responsibilities and needs of graduate students are often much different than undergraduate students who may be interested in a study abroad opportunity. Graduate students can have families to support or may come from families where extended departures from the family unit are actively discouraged. Students from under-represented groups can have additional concerns regarding inclusivity and research climate. Little is known about the participation rates of under-represented groups in international research activities, but there are undoubtedly additional challenges to consider.

Given the multitude of factors that can influence decisions on timing and duration, there is no single best practice that can effectively encompass all of these considerations. Rather, the workshop participants recommended utilizing decision-making tools such as a decision tree to provide guidance to students, research advisors, and program directors on which alternatives are advisable and which are less attractive for international research activities.

Best Practice 3: A decision-tree approach should be used to assist students in determining the optimal timing and duration in order to account for the numerous factors that contribute to these important structural components of an international research visit.

An illustration of how such a decision tree might be structured is given in Figure 1. This example is oversimplified, but it suggests that the duration of an international experience, at least, can be bounded with just a few considerations. Nor is this example intended to imply that the “right” international research experience can be determined from a single set of questions. Like any decision tree, it is simply a tool. It is our hope that in suggesting this approach the community can develop and share more robust decision-making methods that will enhance all aspects of the international research experience.

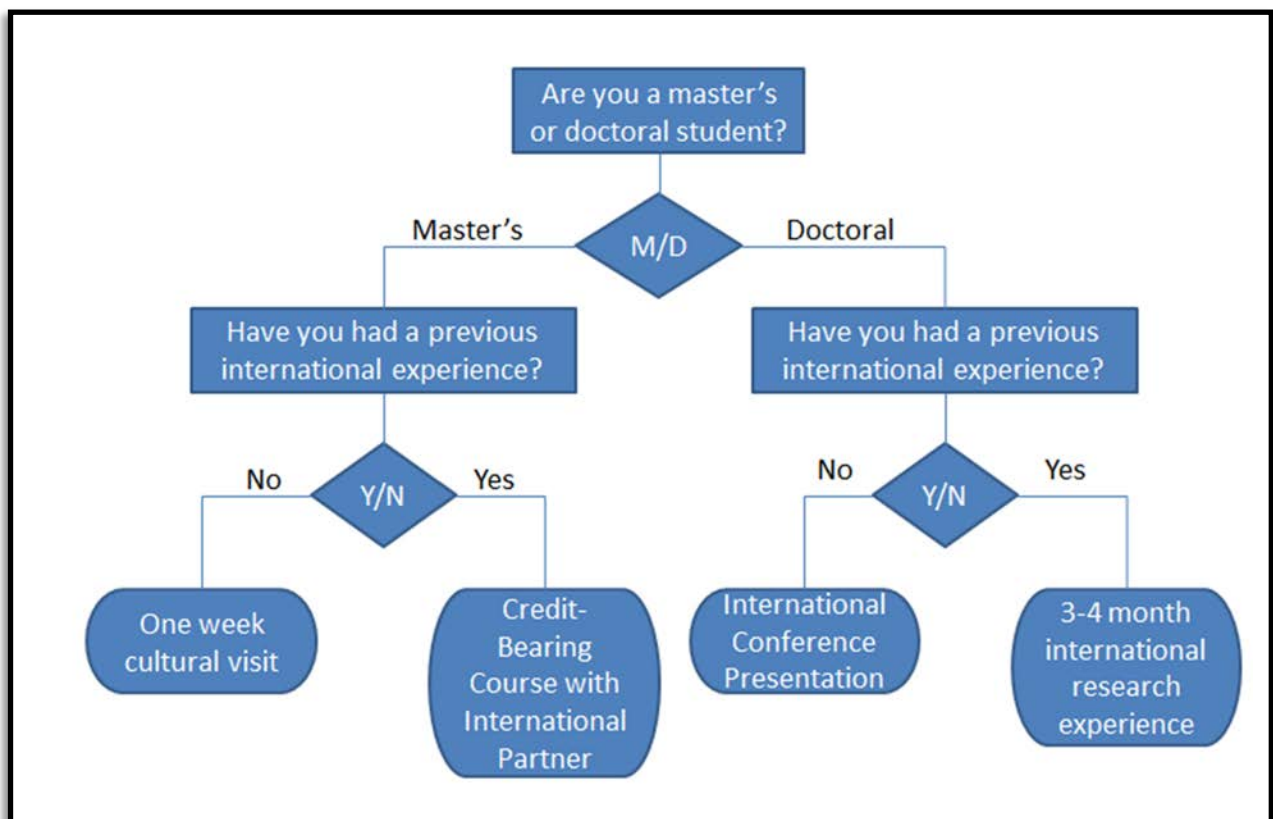


Figure 1 A simplified example decision tree for determining duration of an international research experience.

Tools

- *Demystifying Outcomes Assessment for International Educators*[7] (Deardorff, 2015)
- *Intercultural Competence in Higher Education*[8] (Deardorff and Arasaratnam-Smith, 2017)
- Deardorff, D., "[International Education Outcomes Assessment: A Changing Paradigm](#)," IIE Networker.
- [Global Perspective Index](#) (GPI) and similar evaluative tools. See the [2016 Workshop Report](#), Table 1 for a more comprehensive list of these evaluative tools.

Theme 2: The Role of the Advisor

What is the appropriate role of the student's faculty research advisor (aka PI, research mentor) in identifying, defining, permitting, and evaluating the advisee's international research activity?

In keeping with the recommendation that outcomes shape the timing and duration of the international activity, the workshop participants felt that the key roles of the student's research advisor were to serve as an advocate for the student's professional development aspirations and to evaluate the preparedness of the student for their international research experience. They noted that advisors are often not properly trained to fulfill these roles and that funding mechanisms do not provide adequate support for research advisor training and participation. The workshop participants also recognized that research advisors have concerns about international research experiences that must be addressed if they are to be effective in either of these roles.

Value to the Advisor

A key point of contention in the conversation on international research experiences is the impact the student's experience has not only on the student, but on the research advisor and more broadly the research group to which they both belong. There are those who maintain that the time spent on an international experience will decrease student productivity, while others contend that the student's productivity can actually increase. A similar difference of opinion exists regarding the impact on time to degree. The pre-workshop survey provides at least some framing of research advisor concerns regardless of their overall perception of the value of international research experiences (See Appendix III). Survey respondents felt that securing funding for the student's international placement was by far the greatest challenge or barrier associated with their graduate students going abroad. A potential increase in the student's time to degree was a distant second. Of least concern to the faculty respondents was the sharing of intellectual property, methods, and findings with their international partners. Workshop participants also enumerated barriers to research advisor buy-in during their breakout sessions. These include the aforementioned loss of research productivity and increased time to degree, a lack of their own personal experience with international activities, a perception that international activities take away from the "core experience" of graduate school, and a lack of trust – including losing the student to the foreign institution.

Workshop participants suggested some ways to overcome these barriers. A key barrier is lack of awareness – both of existing international opportunities and their importance to professional development. Advocacy promotes awareness and can occur at many levels. Senior faculty can serve as advocates for junior faculty who are considering promoting international activities for their students. At the level of professional societies and institutions, the importance of international research activities is routinely communicated to constituencies. There is evidence that this advocacy is having an effect. Both U.S.-based and non-U.S. respondents to a recent survey from the American Physical Society (APS) identified preparing young physicists (PhD students, postdocs, early career) for international careers as the top over-arching goal for APS international programs [9] over such goals as increasing international participation in APS leadership or promoting science diplomacy. As mentioned earlier, another barrier is funding. In addition to federally funded programs that may have a higher barrier to participation, institutions should (and often do) provide financial resources for international activities, reduce the

administrative burden on approval for international activities, provide on-campus activities for students to share their international experiences, and recognize successful mentors collectively and through the promotion and tenure process. Finally, workshop participants proposed some unique ways for institutions and funding agencies to promote international collaborations such as creating international teaching experiences rather than solely research experiences, providing for replacement labor while the student is gone, providing resources for distance mentoring, and providing funds for the research mentor to travel with the student for all or part of the international visit.

Table II Example benefits to the research advisor from student international experiences.

- Increased productivity
- Improved research network
- Input to promotion and tenure
- Funding; e.g., add-ons to existing grants
- Community building and collaboration across institutions (also a value to administrators)
- Encourages broader conversations with student

Despite these barriers and negative perceptions, the research advisor stands to gain from international activities. Those gains include leveraging of technical expertise or access to specialized infrastructure and resources, but most of the desirable outcomes for the research advisor fall into the priority of improving one's quality and relevance of research. Workshop participants provided an unranked list of these potential benefits (Table

II). These benefits are similar to those enumerated in other studies, such as motivations for building research partnerships through the Global Innovation Initiative [10]. There was general agreement among the workshop participants that the science must come first; that is, the key reason that the mentor-mentee relationship exists in the first place – the guided generation of new knowledge – must be maintained in any research experience. Beyond that, the research advisor stands to gain increased productivity from the student, an improved research network, and a strengthened advisor-advisee relationship. No clear cause-and-effect relationships between an international research experience and these outcomes have been established. Thus, there is rich opportunity to study the long-term impact of international research experiences from pedagogical and career success standpoints. There are some preliminary findings from previous studies on NSF funded international programs, however, that suggest such relationships may exist.

Dr. Alina Martinez of Mathematica Policy Research gave an overview of evaluation reports from four of NSF's key international research programs: East Asia and Pacific Summer Institutes for Graduate Students (EAPSI, grad students only) [11]; International Research Fellowship Program (IRFP, postdocs only) [12]; Partnerships for International Research and Education (PIRE, both grad students and postdocs) [13] and the soon-to-be-completed report on

Table III Comparison of selected outcomes between NSF-funded students and postdocs performing international research activities with non-funded program applicants. Used with permission.

	EAPSI Grad student	IRFP Postdoc	PIRE Grad student	PIRE Postdoc
Number of publications	No difference	+ ns	+ *	+ *
Quality/citations	NA	NA	+ ns	+ *
Foreign co-authorship	+ *	+ *	+ ns	+ ns
Sustained international collaboration	20% continued collaboration, 80% continued communication	46% sustained collaboration	31% continued collaboration with non-US PIRE colleague + *	29% continued to collaborate with non-US PIRE colleague + ns
ns – difference not significant * - difference significant				

the International Research Experiences for Students (IRES) program. Each of the three published reports contained control groups of unfunded applicants, thereby allowing comparison of certain outcomes between program participants and non-participants. As shown in Table III, there is a general trend of increased number of publications, quality of citations, foreign co-authorship on publications, and sustained international collaboration with international research experiences. Only a portion of the increased productivity differences in these studies is of statistical significance due to the limited sample size; however, at least one recent study has corroborated the finding that publications with authors from at least two countries are cited more often than purely domestically-authored papers [14].

More studies are needed to validate these findings and explore other relationships between international activities and skills development, but there are anecdotes from the workshop that both support the NSF study conclusions and provide additional ways in which the mentor-mentee relationship can be improved. For example, Thomas A. Searles, Assistant Professor, Department of Physics and Astronomy at Howard University described how his NSF PIRE experience in Japan set the stage for his future research collaborations in Ghana, Israel, and France, as well as Japan. At the same time, he described an instance in which equipment he shipped to Japan was held up in customs, severely limiting the time he had to access specialized equipment at the host institution. Similarly, David Sanchez, Assistant Professor of Civil and Environmental Engineering at the University of Pittsburgh explained how his international experiences - including an NSF IGERT program while in graduate school – improved his ability to collaborate, strengthened his understanding of his primary research area in sustainability, and positively impacted his ability to change as a researcher. But he, too, had to deal with issues of housing, visas, timing and scheduling of access to resources, and substandard infrastructure that could have been mitigated to some extent with better planning and preparation. Despite these barriers, faculty members like Profs. Searles and Sanchez, and others like them – like Prof. Kara Spiller at Drexel University who spoke at the 2016 workshop and actively advocates for international research experiences [15] – have had such positive international research experiences that they promote them to their own graduate students and serve as advocates to their professional communities.

Advisor Advocacy

These vignettes show that once a research advisor is confident that an international research experience for their student is potentially beneficial, they can better serve as the student's advocate. Faculty survey respondents clearly put the student's needs ahead of their own. When queried about the single most important reason for sending graduate students on international research experiences, survey respondents listed the student's intercultural growth and networking building more frequently than building their own research collaborations abroad or gaining access to cutting edge ideas, equipment, and expertise. Serving as an advocate means more than endorsing the international research experience. As discussed earlier, it means evaluating the student's readiness for the international activity. It also means reducing institutional barriers to performing international research such as meeting travel, residency, and registration requirements. It means increasing frequency of communication and reduced response time while the student is abroad. It means supporting their engagement with campus and professional organizations upon their return to disseminate the research findings and promote further international collaborations. Rarely are faculties properly prepared to facilitate these aspects of the international research experience.

With these anecdotes, survey results, study findings and expert input in mind, the following two best practices emerged from the workshop with respect to research advisor involvement in international research activities for graduate students:

Best Practice 4: As with all facets of a positive advisor-advisee relationship, a graduate student's research advisor should serve as an advocate for their advisee's international research experience. This includes assessing their readiness, articulating expected outcomes, and facilitating an appropriate international activity to the best of their ability.

Best Practice 5: Institutions should provide training for research mentors on how best to facilitate international research experiences for their graduate students that leverages institutional expertise on such logistical issues as health and safety abroad, deemed export control, immigration status of participants, and the responsible conduct of research in an international setting. Funding agencies could provide grants directly to the institutions, consortia, or regional/national hubs for this research mentor training.

Tools

There are some existing tools that can assist research advisors with their advocacy. These include tools that broadly promote advisor-advisee communication such as Individual Development Plans [16,17], and discipline-specific tools such as those from the American Physical Society that promote preparation of young physicist for international careers [9]. The United Nations maintains a list of [sustainable development goals](#) that list key research areas requiring international collaborative efforts. There are also areas of educational psychology research related to internationalization that are relevant to this discussion such as faculty engagement [18,19], intercultural faculty development [20], peer-to-peer learning, and communities of practice [21,22] to name just a few. An idea to help in training research advisors/mentors might be to partner with the [National Research Mentoring Network](#) (NRMN- NIH) or [Center for the Improvement of Mentored Experiences in Research](#) (CIMER) to create resources on how to work with advisees regarding international travel for teaching and/or research.

Theme 3: Data Collection and Participant Tracking

What are the appropriate entities for assessing the international research activity experiences, defining the appropriate assessment tools, collecting and archiving data, and conducting longitudinal studies on international research experiences?

Two levels of data related to international research activities were identified in the workshop: data collected and maintained in individual institutions; and cross-institutional studies that aggregate common data. They are equally important and inter-dependent but lead to different recommendations on how they are best collected and used. **Institutional-level data** typically focuses on participant level engagement, activities, and occasionally outcomes of program participation. Specific metrics and data collection tools may be developed at the program and/or institutional level. These data are generally designed for program management and reporting purposes, including documentation of activities, promoting participation, and understanding/communicating impact on local campus community and program success. Because these measures are often generated internally, they may not be comparable or aggregable across institutions. A set of cross-institutional studies have developed **aggregated**

datasets that allow for the examination of international experiences for graduate students across multiple institutions. These include common measures and may be best used to identify trends and common elements on a broader scale, and may be useful in assessing broad outcomes on international activities. Because they are cross-institutional and therefore provide a broader set of evidence, they may also be used by institutions to advocate for the value of international experiences for graduate students. Both types of data collection efforts require participation from institutions and programs, but they lead to different conclusions on the broader impacts of international research experiences and global competencies development. Examples of the type of data that could be collected are given in Table IV. These data could be collected over a specified time period, for example a five-year program period.

Data Collection and Sharing

A key outcome of the workshop was the general consensus that institutions of higher education have processes in place to collect much of the participant-level information related to international activities undertaken

by their faculty, staff, and students. This information can be collected through a combination of unit-based leadership (chairs and deans), chief international officers, and institutional research offices through periodic program- and unit-level reporting requirements. If this information can be made available through a data sharing mechanism, then the long-term impacts of international research activities on career development can be evaluated at the aggregate level. There was discussion at the workshop on the creation of a data-coordination consortium to lead such efforts. These observations are consistent with the most recent recommendations from the National Academies of Science, Engineering and Medicine (NASEM) on Graduate STEM Education [23] that include the following on data collection and outcomes assessment:

“Graduate programs should collect, update, and make freely and easily accessible to current and prospective students information about master’s- and Ph.D.-level educational outcomes.” and that “...its outcomes be collected in a standard format, be fully transparent, and be easily accessible and transferable across multiple computer and statistical analysis platforms.”

Table IV Examples of data to collect on international research experiences.

Demographics

- Gender
- MS/PhD
- Nationality
- Race/Ethnicity (as per U.S. categories)
- Broad disciplinary field

Program Structure/Elements

- Program model (individual, cohort, hybrid)
- Funding level and source
- Total number of MS/PhD enrolled
- Total number of participating faculty and their roles
- Length of pre-departure programming
- Elements of pre-departure programming

Program Participation

- Start Date in program
- Start Date for research experience
- Host institution and program
- Country(ies) visited
- Duration of experience
- Total and/or number of visits
- Purpose of research visit

Student-Reported Outcomes

- Competencies and skills
- Publications, presentations, and reports
- Experience sharing

In keeping with the NASEM recommendations, the final recommendation of this report supports fully-transparent data collection efforts on international activities by graduate students at both the institutional and aggregated levels:

Best Practice 6: Programs that sponsor international research activities for graduate students should collect, update, and make freely and easily accessible to current and prospective graduate students information about outcomes of the activity that is collected in a standard format, is fully transparent, and can be easily accessible and transferable across multiple computer and statistical analysis platforms.

Workshop participants had specific suggestions on how to make this information available and readily collectable. One way is through a common *curriculum vitae* (CV) format that includes a separate section for international activities. This section could include information on international conferences attended and research visits with funding and duration information. The use of a common ID such as [ORCID](#) to facilitate tracking of individuals was also discussed. Another example is through shared instruments with validated measures. Institutional exit surveys such as the National Center for Science and Engineering Statistics [Survey of Earned Doctorates](#) fall into this category. Finally, knowledge sharing through presentations and joint panels at scientific, international education, and institutional research conferences such as the American Association for the Advancement of Science ([AAAS](#)), Association of International Education Administrators ([AIEA](#)), and Association of Institutional Research ([AIR](#)) was strongly encouraged.

Benefits of this shared instrument approach are starting to emerge. Preliminary results presented by Julia Kent and Hironao Okahana of the Council of Graduate Schools (CGS) from their Fall 2017 Alumni Survey of the Understanding PhD Career Pathways for Program Improvement Project funded by the National Science Foundation (NSF # 1661272) and the Andrew W. Mellon Foundation suggest that today's PhD recipients have participated in international research experiences at a higher rate than their predecessors. This is true across all disciplinary categories. The NIH Broadening Experiences in Scientific Training (BEST) program has developed different shared instruments across institutions. A shared faculty survey instrument across five institutions illustrates how even simple survey data can be used to draw conclusions on program participants or outcomes [24]. Although unrelated directly to international research experiences, sample findings specific to doctoral trainee career development showed variation across institutions in the time that postdocs should spend on career development training than graduate students. In another NIH BEST survey study using an instrument adopted across 17 institutions, analysis in two institutions showed how variation in career-search efficacy mattered in career development resource strategies and preferences [25]. Similar efforts are now underway to collect evidence on the impact of graduate education practices, such as the use of [individual development plans in STEM disciplines](#), and the establishment of a [National Center for Advancing the Career Development of Scientist](#), both funded with NSF grants through the Division of Graduate Education.

These examples highlight a key shortcoming in current data collection efforts related to international research activities, namely, the type of information that is collected. As invited speaker Julia Melkers of the Georgia Institute of Technology noted in her [workshop presentation](#), most of the factors identified

in this workshop as important to understanding international research experiences are not tracked in existing institutional data collection efforts. Those efforts are based on traditional models of doctoral education and include measures of academic persistence, advancement, placement and productivity; new efforts are needed to collect information not only to catalog the activities, but to evaluate key outcomes as described previously in this report (see Table IV, for example). A definitive list of the necessary data needed to evaluate the impact of international research experiences does not currently exist, but theoretical frameworks to characterize the global traits of the scientific workforce [26] are being developed and discussed. Explicit requests in calls for proposals by funding agencies on what information is collected and how it is to be collected would advance this effort tremendously.

Funding for Data Collection and Sharing

As in the 2016 Workshop Final Report [4], workshop participants again called for funding agencies to financially support data collection efforts on international research activities. Institutions must be both incentivized to participate in data collection efforts and be provided with the appropriate tools and support to effectively do so. Such financial support need not go directly to participating institutions from the funding agency; third parties such as the National Academies for Science, Engineering, and Medicine (NASEM), the Council of Graduate Schools (CGS), Institute of International Education (IIE), or even regional hubs organized by lead institutions were suggested as possibilities for organizing data collection efforts. Nevertheless, workshop participants felt that annual and final project reports to NSF could be made more robust with required student-level data for international activity participants. This information could be used for both summative and formative project evaluations as well as by the broader community for global skills assessment.

Privacy Concerns

As with any data collection project involving human subjects, privacy concerns and regulations must be considered. Workshop participants felt that there was nothing fundamentally different about data on international research activities that required additional safeguards, and that existing institutional review board (IRB) and data privacy practices were generally sufficient to support such data collection efforts. There are emerging privacy policies in the international community that should be closely monitored, such as the [European Union General Data Protection Regulation](#) (GDPR). There was an additional concern that the limited information on international research activities makes it difficult to draw statistically-significant conclusions, especially where race and ethnicity information are concerned.

Data Analysis and Longitudinal Studies

Workshop participants pointed to the need for more long-term studies on the effects of international research experiences on career preparation and success. Such studies could reside within institutions, but in order to be of maximum benefit to the higher education community, results of studies should be published in the open literature. There are a number of existing and emerging frameworks into which these studies could be incorporated. In addition to the efforts of the NIH BEST program and CGS Career Pathways projects described above, the National Center for Advancing the Career Development of Scientists will be holding a multi-stakeholder workshop in Summer 2019 to discuss methods for streamlining dissemination of evidence-based graduate education practices. Global competency development and international research activities will be a part of those framework discussions.

Tools

- [Vertically Integrated Projects \(VIP\) Consortium](#)
- [NIH Broadening Experiences in Scientific Training \(BEST\) Program Consortium](#)
- [Council of Graduate Schools Understanding Career Pathways for Program Improvement](#)
- [Center for the Improvement of Mentored Experiences in Research](#)
- [Student Assessment for Learning Gains](#) (SALG)

Recommendations

The best practices from the three research topics comprise the recommendations from this workshop:

- In considering the timing and duration of a graduate student's research visit, an **evaluation of their interpersonal and cognitive skills development** should be undertaken in order to determine their readiness for the experience.
- The intended outcomes, skills development, and competencies of an international research experience should be enumerated and a corresponding **evaluation plan** with both formative and summative components developed prior to the research visit.
- A **decision-tree approach** should be used to assist students in determining the optimal timing and duration in order to account for the numerous factors that contribute to these important structural components of an international research visit.
- As with all facets of a positive advisor-advisee relationship, a graduate student's research advisor should serve as an advocate for their advisee's international research experience. This includes assessing their readiness, articulating expected outcomes, and facilitating an appropriate international activity to the best of their ability.
- Institutions should provide **training for research mentors** on how best to facilitate international research experiences for their graduate students that leverages institutional expertise on such logistical issues as health and safety abroad, deemed export control, immigration status of participants, and the responsible conduct of research in an international setting. Funding agencies could provide grants directly to the institutions, consortia, or regional/national hubs for this research mentor training.
- Programs that sponsor international research activities for graduate students should **collect, update, and make freely and easily accessible to current and prospective graduate students** information about outcomes of the activity that is collected in a standard format, is fully transparent, and can be easily accessible and transferable across multiple computer and statistical analysis platforms.

The purpose of these recommendations is to assist faculty, staff and administrators at U.S. institutions of higher education with the development and evaluation of sound international research programs, to assist U.S. funding agencies with the specifics of their calls for proposals involving international collaborations, and to assist students interested in international research experiences with identifying the key aspects of their career development those activities will impact.

Acknowledgments

The Advisory Committee wishes to thank all who participated in the workshop, and provided content for and reviewed versions of this report. The administrative support of Ms. Danielle Scanlon is greatly appreciated. This material is based upon work supported by the National Science Foundation under Grant No. 1840364. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Appendix I: Conference Agenda

January 10, 2019

8:30 AM Welcome and Overview

Prof. Brian S. Mitchell, Interim Associate Dean, School of Science and Engineering, Tulane University

- Supporting Document 0.A – Report from the 2011 Workshop
- Supporting Document 0.B – Report from the 2016 Workshop
- Supporting Document 0.C – NSF DCL 2018

9:00 AM Session 1: Timing and Duration of International Research Stays

What are the appropriate timing and duration for introductory, follow-on, and subsequent international research experiences during a STEM PhD student's training? What about a STEM master's student?

1. Prof. Carol A. Handwerker, Materials Engineering, Purdue University: "Sustainable Electronics – International Research Experience in India."
2. Dr. Alina Martinez, Senior Researcher, Mathematica Policy Research: "International Research Experiences: Selected Findings from Evaluations of NSF OISE Programs."

Moderator: Prof. Brent Jesiek, School of Engineering Education and School of Electrical Engineering, Purdue University

10:30 AM Break Out Groups

11:30 AM Group Reports

12:00 PM Lunch and Keynote Speaker

Layne Scherer, Program Officer, National Academies of Science, Engineering, and Medicine: "Graduate STEM Education for the 21st Century."

- Supporting Document K.A – Summary Report
- Supporting Document K.B – Full Report (Free PDF but requires free email login)

1:30 PM Session 2: The Role of the Research Advisor

What is the appropriate role of the student's faculty research advisor (aka PI, research mentor) in identifying, defining, permitting, and evaluating the advisee's international research activity?

1. Prof. Thomas Searles, Department of Physics and Astronomy, Howard University
2. Prof. David Sanchez, Department of Civil and Environmental Engineering, University of Pittsburgh

Moderator: Dr. Mary Besterfield-Sacre, Associate Dean for Academic Affairs, Swanson School of Engineering, University of Pittsburgh

3:00 PM Break Out Groups

4:00 PM Group Reports

4:30 PM Adjourn

January 11, 2019

8:30 AM Summary of Day 1 Activities

8:45 AM Session 3: Data Tracking and Longitudinal Impact

What are the appropriate entities for assessing the international research activity experiences, defining the appropriate assessment tools, collecting and archiving data, and conducting longitudinal studies on international research experiences?

1. Prof. Julia Melkers, School of Public Policy, Georgia Institute of Technology: “Data Issues Across Institutions and Time: Learning from Student Consortium-Based Initiatives.”

2. Dr. Julia Kent/Dr. Hironao Okahana, Council of Graduate Schools: “Using Actionable Data to Understand and Improve International Experiences for Graduate Students.”

Moderator: Dr. Rajika Bhandari, Senior Advisor, Research and Strategy, IIE

10:15 AM Break Out Groups

11:15 AM Group Reports

11:45 AM Workshop Summary and Workshop Evaluation

12:30 PM Adjourn

Appendix II: List of Attendees

Guillermo Aguilar	Professor and Chair, University of California Riverside
Caren Arbeit	Research Analyst, RTI International
Mary Besterfield-Sacre	Associate Dean of Academic Affairs, University of Pittsburgh
Rajika Bhandari	Senior Advisor, Research and Strategy, IIE
Katya Bitkin	Research Associate, Northwestern University
Susan Brennan	Professor, Stony Brook University
Leslie Calman	CEO, Engineering World Health
Lindy Cranwell	Director of International & Graduate Education, Virginia Tech
Huw Davies	Professor, Emory University
Darla Deardorff	Executive Director, AIEA
Karen DePauw	Vice President and Dean for Graduate Education, Virginia Tech
Lee Ferguson	Associate Professor, Duke University
John Godfrey	Assistant Dean for International Education, University of Michigan
Carol Handwerker	Schuhmann Professor of Materials Engineering, Purdue University
Linda Hanley-Bowdoin	William Neal Reynolds Distinguished Professor, North Carolina State University
Michele Irwin	International Programs Manager, American Physical Society
Brent Jesiek	Associate Professor, Purdue University
Julia Kent	Vice President, Best Practices and Strategic Initiatives, Council of Graduate Schools
Juan Lucena	Professor and Director, Colorado School of Mines
Alina Martinez	Senior Researcher, Mathematica Policy Research
Cheryl Matherly	Vice President/Vice Provost, Office of International Affairs, Lehigh University
Julia Melkers	Associate Professor, Georgia Institute of Technology
Sai Menon	Program Administrator, Kansas State University
Mark Miller	University of Puerto Rico Medical Sciences Campus
Brian Mitchell	Professor, Tulane University
Hironao Okahana	Associate Vice President, Research & Policy Analysis, Council of Graduate Schools
Suzanne Ortega	President, Council of Graduate Schools
Adina Paytan	Research Professor, University of California Santa Cruz
Shashank Priya	Associate Vice President for Research and Director of Strategic Initiatives, The Pennsylvania State University
Gisele Ragusa	Professor, University of Southern California
Alison Robertson	Senior Marine Scientist/Assistant Professor, University of South Alabama/The Dauphin Island Sea Lab
Gerrit Roessler	Program Manager, German Center for Research and Innovation/DAAD
Janet Rutledge	Vice Provost & Dean of the Graduate School, University of Maryland, Baltimore County
David Sanchez	Assistant Professor, University of Pittsburgh
Danielle Scanlon	Project Assistant, Tulane University
Layne Scherer	Program Officer, National Academies of Science, Engineering & Medicine
Joerg Schlatterer	Manager, Graduate & Postdoctoral Scholars Office, American Chemical Society
Thomas Searles	Assistant Professor, Howard University
Padhu Seshaiyer	Associate Dean for Academic Affairs, George Mason University
Kara Spiller	Associate Professor, Drexel University
Kyle Squires	Dean of Ira A. Fulton School of Engineering, Arizona State University
Maryanne Walker	Director, Global Engineering Office, Michigan State University
Gregg Warnick	Director, Weidman Center for Global Leadership, Brigham Young University

Appendix III Pre-Workshop Survey

Static images of the now-closed Qualtrics survey are shown on the following pages.

Default Question Block

Faculty Perspectives on International Research Experiences for Graduate Students

To prepare for an upcoming workshop (NSF grant no. 1840364, “Best Practices in Evaluating Research Experiences for Graduate Students”), we are inviting faculty from all fields covered/supported by NSF to complete a brief survey. Participation is strictly voluntary, and no identifying information is collected as part of the study procedures. All respondents must be 18 years of age or older. Estimated completion time is 10 minutes.

Any questions or concerns about this study should be directed to investigator Brent K. Jesiek, Ph.D., School of Engineering, Purdue University, e-mail bjesiek@gmail.com, phone +1-765-496-1531.

I have mentored (or co-mentored) graduate students as their research advisor in the course of their masters or PhD work.

☐ Yes

☐ No

Part 1 of 2

Please answer the following questions in your role as a research mentor of graduate students.

1. An international research experience is an important part of a graduate student’s professional development.

Strongly disagree

☐

Disagree

☐

Neither agree nor
disagree

Agree

☐

Strongly agree

☐

2. I think the National Science Foundation should provide funds to support international research experiences for graduate students.

Strongly disagree Disagree Neither agree nor disagree Agree Strongly Agree

☐ ☐ ☐ ☐ ☐

3. What is the BEST mechanism for collecting information on graduate students who participate in international research experiences?

- ☐ Through the NSF program sponsoring the international research activity
- ☐ Through students' home institutions
- ☐ Through a relevant professional society
- ☐ Through an independent higher education organization (e.g., National Research Council, Carnegie Foundation, Institute of International Education, NAESA, Council of Graduate Schools, etc.)

4. Does your institution provide funds for graduate students to perform international research visits?

- ☐ Yes
- ☐ No
- ☐ Not sure

If you answered "Yes" to the previous question, please describe how these institutional funds are administered, including source of funds, typical amount of award, any conditions or limitations on award, and reporting/assessment activities.

5. What do you think is the optimal duration of a single, inaugural international research experience for graduate students?

- ☐ 1-2 months
- ☐ 3-4 months
- ☐ 5-6 months
- ☐ 7-11 months
- ☐ 12 months or longer

Additional comment/explanation:

6. What do you think is the optimal timing of a single, inaugural international research experience in the graduate student's career?

- ☐ Before graduate school
- ☐ Before comprehensive/qualifying exams
- ☐ After comprehensive/qualifying exams but before prospectus/preliminary/research plan examination
- ☐ After prospectus/preliminary/research plan exam but before dissertation defense
- ☐ After graduate school (during post-doc or before starting entry-level position)

Additional comment/explanation:

7. Which of the following factors/reasons do you see as MOST IMPORTANT for sending graduate students on an international research experience?

- ☐ Your student's intercultural growth and development
- ☐ Build or maintain your research collaborations with colleagues/labs abroad

- ☐ Build or maintain your student's network with colleagues/labs abroad
- ☐ Gain access to cutting edge ideas, equipment, expertise, etc. abroad
- ☐ Secure or support multi/cross-national funding for your research
- ☐ Other:

Additional comment/explanation:

8. Which of the following do you see as the biggest CHALLENGES/BARRIERS associated with graduate students going abroad for an international research experience? (Select all that apply.)

- ☐ Potential increase in your student's time to graduation/degree
- ☐ Decrease in staffing/productivity during the period when your student is abroad
- ☐ Overhead associated with arranging and supervising your student's international placement
- ☐ Challenges associated with securing funding for your student's international placement
- ☐ Difficulty finding an appropriate placement/location/collaborator to host your student
- ☐ Cultural and/or language barriers associated with going abroad
- ☐ Family and/or other personal constraints that make it difficult for a student to go abroad
- ☐ Uncertain benefits regarding student's research outcomes and/or professional development
- ☐ Concerns about sharing intellectual property, methods, findings, etc. with partners abroad
- ☐ Other:

Additional comment/explanation:

Part 2 of 2

Please tell us a little more about yourself so we can better understand how your own professional preparation impacts your support for international research experiences.

What is your academic rank?

☐ Assistant Professor

☐ Associate Professor

☐ Full Professor

☐ Other:

Which NSF area of interest do you primarily identify with? (select one)

☐ Biological Sciences

☐ Computer and Information Sciences & Engineering

☐ Geosciences

☐ Engineering

☐ Mathematical and Physical Sciences

☐ Social, Behavioral, and Economic Sciences

☐ Other:

Have you ever received NSF funding, either individually or as part of an NSF-sponsored center?

☐ Yes

☐ No

Have you had an international research experience at any point in your professional development? This could include study abroad as an undergraduate student, visiting an international research lab as a graduate student, completing an international post-doc assignment, or coming to the U.S. as a foreign-trained researcher, just as a few examples.

☐ Yes

☐ No

Do you have active research collaborations with investigators outside the U.S., regardless of whether or not you send students or postdocs abroad?

☐ Yes

☐ No

Were you born and/or educated outside of the United States?

☐ Yes

☐ No

How many of your graduate student advisees have completed an international research experience?

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