



Pathways to Broadening Participation in Response to the CEOSE 2011-2012 Recommendation

The purpose of this document is to build on best practices and offer new approaches toward creating "a bold new initiative" to augment the Foundation's ongoing efforts to increase participation in STEM from underrepresented groups.

PATHWAYS TO BROADENING PARTICIPATION IN RESPONSE TO THE CEOSE 2011-2012 RECOMMENDATION

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Executive Summary of the Broadening Participation Working Group Report on the NSF Response to the CEOSE Recommendation

Summary of the CEOSE Recommendation

The 2011-2012 CEOSE (Committee on Equal Opportunities in Science and Engineering) report requested that NSF launch a **bold new initiative** for broadening participation (BP) with the goal of eventually having the participation of NSF-supported scientists and engineers in Science, Technology, Engineering, and Math (STEM) fields mirror the population of the Nation. This initiative would recognize, adapt, and expand successful "best practices" in broadening participation and promote transformative research on the science of broadening participation; careful analysis and widespread dissemination of results would subsequently inform future research and investments to achieve the goals of diversity, inclusion, and parity.

This bold new initiative would have specific goals and components, including: **institutional and systemic change** to address recruitment, progression, and advancement in the federal and academic STEM workforce; focus on interventions that are **scalable** nation-wide; **Integration** of current research results on BP and education into interventions, especially interventions aimed at training; use of **innovative, longitudinal analysis** to quantify the success of broadening participation efforts, including innovation in monitoring, assessment, and evaluation; **Adoption of defined benchmarks** for all aspects of broadening participation (e.g., by disciplines, education levels, type of research, and type/phase of implementation activities, etc.); support for **translation, replication, and expansion of what works** to broaden participation, such that innovation and scaling are not competing activities for funding; **coordination of research centers and projects across levels of schooling**, from pre-K to 20+, and including informal and informal learning experiences and environments; provision of **direct financial support** to individuals (students, postdoctoral fellows, faculty, and practitioners) as investigators in broadening participation; promotion of **interagency and private sector partnerships** for shared vision, financial resources, implementation and dissemination; and, **long-term commitment** to impact STEM employment, education, and research.

Broadening Participation Working Group Recommendations

The NSF BP Working Group developed a matrix representing an array of options for NSF to augment its ongoing activities in broadening participation in STEM and respond to the 2011-2012 CEOSE recommendation (see Full Report, "Pathways to Broadening Participation in Response to the CEOSE 2011-2012 Recommendation"). The matrix outlines a range of NSF activities beginning with the end of FY14 (i.e. August and September) through FY16. These ideas can also help inform NSF-wide activities envisioned under the INCLUDES programs. These activities range from those very easy to implement quickly, such as an IdeaShare site to gather ideas on BP from NSF staff, to large-scale high investment activities such as Centers devoted to the science of broadening participation, or to broadening participation itself. Here we outline three levels of activities that NSF could pursue:

Near-term, low cost activities:

IdeaShare activities: NSF employees, those serving NSF on Intergovernmental Personnel Act assignments (IPAs) and Visiting Scientists are an excellent resource of ideas about NSF priorities and mechanisms for broadening participation. We should tap into this wealth of experience and hold one or several IdeaShare activities designed to generate ideas about investments of varying size in the broadening participation initiative. IdeaShare challenges for broadening participation ideas could be undertaken during Fiscal Year (FY) 2015.

Use of community blogs: Blogs could serve as a reciprocal resource for NSF and the scientific communities. Blogs could generate conversations with scientists and/or educators about cutting-edge findings related to

the science of broadening participation, and how to best implement and scale up these best practices. This would also be low cost, but could have a high impact in terms of providing forums for dialogue and information-sharing between different stakeholders.

Supplemental funding: Supplemental funding is a major, low-risk mechanism by which NSF could augment its activities in broadening participation. Through Dear Colleagues Letters (DCLs) and other means, NSF programs and Divisions could notify the principal investigator (PI) community that increased emphasis on supplements will take place, and could outline a variety of supplement types that could be made. The particular demographic targets of supplements may vary by Directorate or Division, depending on the needs of the discipline. These could start as early as FY15.

Mid-scale activities:

Community Design Projects: Community Design Projects are considered high-risk but low impact and would essentially include awards that address local or regional broadening participation efforts, including course and curriculum improvement, inclusion of culturally relevant pedagogies, faculty development, and institutional capacity building efforts. As a lower-risk strategy, replication of proven strategies that have been shown to enhance recruitment, retention, engagement, and persistence in STEM, such as bridge programs, cohort models, mentoring, and research experiences through internships and other mechanisms, should also be explored. Research has also highlighted the importance of addressing campus climate and culture as a contributor to successful broadening participation efforts. Examples of community design programs that can be translated into a broadening participation framework are the Partnership for Undergraduate Life Science Education (PULSE) activities spearheaded by the Directorate of Biological Sciences (BIO) and the NSF-wide Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE) program. Additionally, scientific societies could play a major role in deploying best practices to the community and pursuing broadening participation.

Large-scale initiatives:

Broadening Participation Institutes/Partnerships/Centers: High risk - medium investment options include Broadening Participation Centers that focus on building the knowledge base on broadening participation research, as well as augmenting the pool of scientists from underrepresented groups. While some of NSF's existing research centers may already include broadening participation as a goal, this and other new initiatives would call for new centers to be created with broadening participation as the central mission and the foundation for all other activities. There is also a need to translate broadening participation research to practice, integrating it into scalable programs for widespread dissemination. The NSF Science of Learning Centers provide a good model and set of goals that might be used to inform similar centers focused exclusively on broadening participation.

Large-scale national initiatives: The need for a robust STEM workforce has been reiterated in recent reports by the National Research Council (NRC), President's Council of Advisors on Science and Technology (PCAST) and the National Science Board (NSB). These reports offer extensive recommendations for strategies for addressing persistent disparities in racial, ethnic, and gender representation in STEM specifically by strengthening K-12 education, increasing student interest and motivation in STEM, and by increasing the number of underrepresented students successfully completing undergraduate STEM degree programs and who wish to pursue STEM careers. Large scale, national initiatives that address the full spectrum of the educational trajectory, from pre-kindergarten to graduate school and beyond are considered bold activities requiring large investment. It is critical for any national initiative to create appropriate public and private partnerships and include strategies with a visible impact in the form of systemic changes. By taking a systems approach, NSF can help remove some of the barriers embedded in academic, social, and occupational systems that currently impede progress for underrepresented groups at all levels.

NSF Leadership in Broadening Participation Coordination and Communication

On the whole, NSF has a strong commitment to broadening participation activities. However, NSF's impact in broadening participation could be greater if we identify strategic goals for broadening participation that involve all Directorates, as well as increase the number of budgeted emphasis programs that directly target broadening participation. Additionally, effective communication throughout NSF is paramount. Although broadening participation must be an activity encompassing all of NSF and to which all NSF feels responsible, effective communication and coordination of activities will be enhanced via a NSF-wide committee responsible for the charge. Working with the Director, this committee would have representation from all NSF Directorates and could make clear the importance that the agency places on broadening the participation of underrepresented groups in science.

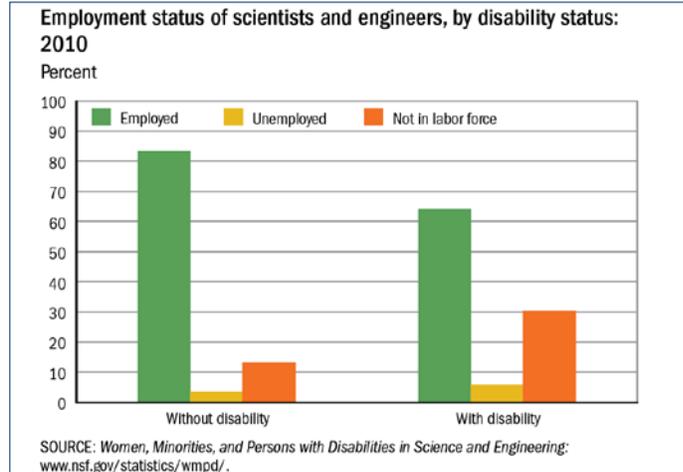
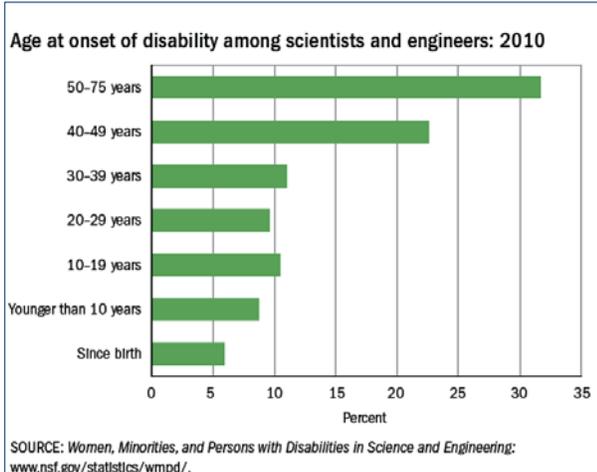
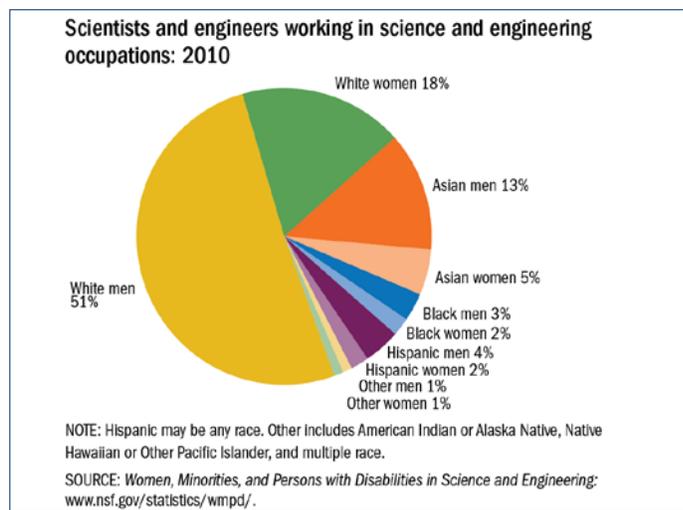
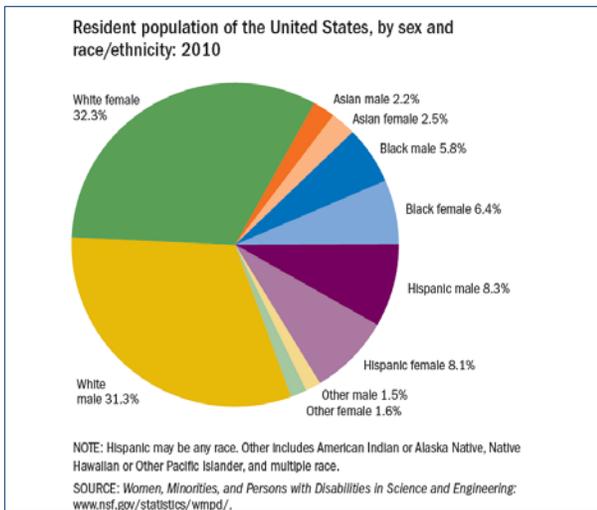
The Committee could help coordinate broadening participation activities across NSF, help share best practices around the Foundation, provide recommendations for diverse activities including new funding activities; increasing the prominence of broadening participation language in the merit criteria and NSF solicitations; enhancing the NSF broadening participation website, thereby providing a resource for best practices and NSF funding programs as well as demographic information by subfield and links to discipline-specific resources; providing guidance on ways to educate the scientific community, reviewers and panelists about the importance of broadening participation in NSF projects, and best practices that make such efforts effective. These scientists and communities can then be effective ambassadors for NSF's broadening participation mission as a whole.

Concluding Comments

The NSF BP Working Group consensus is that NSF should develop a multidimensional strategy that is responsive to the 2011-2012 CEOSE recommendation and demonstrates the core value of being broadly inclusive. This report has identified a broad range of activities to: accelerate a Foundation-wide engagement to achieve a diverse STEM workforce and enhance the Foundation's intellectual and financial commitments to broadening participation for societal benefits as well as the continuing advancement of scientific research and education frontiers. A knowledge-driven and evidence-based context should underpin the opportunities for innovations in broadening participation across and within disciplinary and interdisciplinary STEM portfolios. In addressing scale and scope, the strategic framework for the future should: address the diverse needs within the underrepresented groups and within scientific fields regarding participation and performance outcomes, leverage the integration of a core group of strategies that are successful across disciplinary boundaries regarding broadening participation, and explore new opportunities for collaborative models that address specific and shared broadening participation challenges. This multidimensional strategy will also need more creative means of measuring process and making claims of success for moving the broadening participation needle for all underrepresented groups: women, underrepresented racial/ethnic groups, and persons with disabilities. The NSF response to the call for a "bold new initiative" must be a focused effort resulting in new knowledge about participation in science and engineering, effective diversity practices for dissemination including scaling up, and partnerships for greater inclusive investments in STEM. NSF must continue its leading role in broadening participation, which is a key component of broader impacts, a core value of the agency, and a recommendation advocated by NSF advisory committees to help address complex scientific and societal challenges.

Section 1: Overview of the Problem and the Charge

The National Science Foundation (NSF) recognizes that the challenges to the national competitiveness and sustained STEM global leadership can be better met through the full utilization of all of the nation’s talent and resources (NSF, 2014). Recently, the Committee on Equal Opportunities in Science and Engineering (CEOSE) acknowledged the incremental progress of the NSF BP investments in policies, programs, and activities to increase the participation of African Americans, Hispanics, American Indians, Alaska Natives, Native Hawaiians and other Pacific Islanders, women and persons with disabilities in science, technology, engineering, and mathematics (STEM) careers but concluded that bolder steps and bigger investments are needed to improve the state of diversity and inclusion in science and engineering as shown in the data below (CEOSE, 2013; NCSSES, 2013).



With this context the NSF Broadening Participation Group was charged to:

Develop options in response to the 2011-2012 CEOSE recommendation that ***“NSF should implement a bold new initiative, focused on broadening participation of underrepresented groups in STEM that emphasizes institutional transformation and system change; collects and makes accessible longitudinal data; defines clear benchmarks for success; supports the translation, replication and expansion of successful broadening participation efforts; and provides significant financial support to individuals who represent the very broadened participation that we seek”*** (NSF, 2014; CEOSE 2013).

The remainder of this document focuses on pathways to institutional transformation and systemic change, giving attention to scope and scale, innovation and integration, and accountability.

Section 2. Our Understanding of the CEOSE Recommendation

The 2011-2012 CEOSE report had only one recommendation: that NSF should implement a **bold new initiative** for broadening participation. This initiative would recognize, adapt, and expand successful "best practices" in broadening participation and promote transformative research on the science of broadening participation; careful analysis and widespread dissemination of results would subsequently inform future research and investments to achieve the goals of diversity, inclusion, and parity.

This bold new initiative would have specific goals and components, including:

- Emphasis on **institutional and systemic change** to address recruitment, progression, and advancement in the federal and academic STEM workforce;
- Focus on interventions that are **scalable** and thus have potential impacts well beyond the institutions directly involved.
- **Integration** of current research results on BP and education into interventions, especially interventions aimed at training;
- Use of **innovative, longitudinal analysis** to quantify the success of broadening participation efforts, including innovation in monitoring, assessment, and evaluation;
- **Adoption of defined benchmarks** for all aspects of broadening participation (e.g., by disciplines, education levels, type of research, and type/phase of implementation activities, etc.);
- Support for **translation, replication, and expansion of what works** to broaden participation, such that innovation and scaling are not competing activities for funding;
- **Coordination of research centers and projects across levels of schooling**, from pre-K to 20+, and including formal and informal learning experiences and environments;
- Provision of **direct financial support** to individuals (students, postdoctoral fellows, faculty, and practitioners) as investigators in broadening participation. This could take on different forms, including stipends, scholarships, fellowships, research awards, etc.;
- Promotion of **interagency and private sector partnerships** for shared vision, financial resources, implementation and dissemination; and,
- **Long-term commitment** to impact STEM employment, education, and research.

The initiative is "bold" in that it focuses not only on basic research on broadening participation, but also on institutional transformation and systemic change. We define "institutional and systemic change" quite broadly, intending to include institutions of higher education as well as institutions of primary and secondary education, informal education, professional organizations, community organizations, and industry. Change at these levels requires a long-term commitment of resources to substantially "move the needle" and alter trajectories in STEM education and employment. The results of this action would enable underrepresented groups to contribute their full talent and innovation to scientific and technological advances.

The ultimate goal is to have participation in STEM fields mirror the population of the Nation. Every person interested in science and engineering should be able to consider a STEM career without concern about whether or not “people like me” fit into the STEM enterprise. The Nation should have the full benefit of a well-educated and scientifically literate population. Strategic goals during this new initiative will guide the process as NSF and CEOSE together work towards the ultimate goal of full utilization of the Nation’s greatest wealth – its people.

It is important to note that different science and engineering fields have differing cultures and somewhat different challenges. In some fields, for example, women are present at many levels of academia and industry, but are not well represented at the top levels, or in certain subfields. In other fields, the participation of women is low at every point. The same is true to a lesser extent for other underrepresented groups, which tend to be underrepresented at every stage in most science and engineering fields. These strategic goals should reflect this reality, and could include:

- Create, collect, vet, and disseminate research on underrepresentation and best and promising practices across the sciences, but also within sub-disciplines;
- Build networks across disciplines and sub-disciplines to address issues of broadening participation, both at the larger STEM scale and at the more focused sub-discipline scale; and
- Effect real and measureable change in the numbers of underrepresented groups in each discipline and sub-discipline.

See Appendix A for a preliminary inventory of NSF’s focused efforts aligned with the CEOSE-suggested components, “CEOSE’s Call for a Synergistic, Pathway Approach and What NSF Has Supported.”

NSF BROADENING PARTICIPATION OPTIONS

Level of Investment by Level of Boldness (Size and Novelty of Effort) versus Potential Impact

		POTENTIAL IMPACT		
		LOW	MEDIUM	HIGH
FY16	High	<ul style="list-style-type: none"> ✦ Call for Community Design Projects in response to the 2011-2012 GEOSE recommendation ✦ Provide funding for BP infrastructure that PIs could “plug in” to for meaningful BP Broader Impacts 	<ul style="list-style-type: none"> ✦ Call for BP Institutes/Centers conducting BP research and increasing the number of UR scientists and engineers ✦ Call for Partnerships/Centers that can translate BP research into scalable programs for widespread dissemination¹ 	<ul style="list-style-type: none"> ✦ Call for large-scale BP partnerships that cover research, implementation and scaling across preK-20+, focusing on institutional and systemic outcomes²
	Medium	<ul style="list-style-type: none"> ✦ Increase the availability of BP Supplements via DCLs from directorates ✦ Make available BP data by subfields ✦ Encourage PIs/faculty to participate in diversity meetings ✦ Form a Rotator Corps for BP ✦ Expand Science: Becoming the Messenger Workshop to have a BP focus 	<ul style="list-style-type: none"> ✦ Support additional replication of successful implementations³ or additional partnering with model BP programs⁴ ✦ Leverage efforts like REU, I-Cubed (I³), PULSE, etc. ✦ Make supplemental funding available to <u>all</u> NSF research centers for BP goals (contingent on strong existing efforts) ✦ Engage STEM Diversity Organizations and have an NSF BP presence at their national meetings 	<ul style="list-style-type: none"> ✦ Increase in number of Emphasis and other programs reaching the 50% threshold⁵ ✦ Offer support for mid- and large-scale BP theoretical studies with potential for large scale implementation ✦ Identify strategic goals for BP for NSF that address all directorates. ✦ Increase the prominence of BP language in the merit review criteria and in Annual and Final reporting
	Immediate Implementation	<ul style="list-style-type: none"> ✦ Provide BP Memo to NSF Staff from the Director ✦ Enhance BP website with best/promising practices ✦ More systematically inform NSF staff about best practices in BP ✦ Form an agency-wide BP advocacy group to increase communication and identify cross-agency BP goals 	<ul style="list-style-type: none"> ✦ Provide Important Notice to Community about BP ✦ Establish BP Policies for Workshops Agency-wide (see BIO) ✦ More systematically inform panelists and reviewers about best practices in BP ✦ Support NSF-wide workshops on BP from experts in the BP field 	<ul style="list-style-type: none"> ✦ Increase the prominence of BP language in solicitations, on NSF website and via social media used by OLPA ✦ Use community blogs to promote BP discussions ✦ Create BP IdeaShare for gathering ideas/input, etc.

¹ See perts.net and [NCWIT](http://ncwit.org).

² See the [BPC Alliance Program](#) in aggregate and former Systemic Initiatives, such as USP and RSI.

³ See Page 12, Institutional Commitment to Leadership at Colleges and Universities to increase Diversity in Engineering and Science, a version of ADVANCE.

⁴ See [GEO LSAMP](#), and [MPS AGEP](#).

⁵ See [Budget Table for Programs to Broaden Participation](#) for FY2015.

Section 3. Recommendations of the NSF Broadening Participation Working Group: Diverse Activities of Varying Boldness and Investment

The matrix on the previous page presents an array of options for NSF to augment its ongoing activities in broadening participation in STEM. The rows highlight the activities in terms of increasing boldness, from bottom to top, as judged by the BP Working Group. Low-boldness activities include a number of activities that NSF has undertaken in the past, but which could be amplified or reinstated. Medium-boldness activities include more systemic changes and increased emphasis on NSF activities such as supplements, replication of activities that are now practiced in one or a few Directorates, as well as larger initiatives and bolder metrics. Activities characterized as the most bold include planning or implementation of activities that NSF has not attempted before. On the columns, activities are ranked by increasing impact, moving from left to right. The BP Working Group discussed at length the relationship between investment and impact. The BP Working Group agrees that the relationship can be indirect and the one does not necessarily scale with the other. Thus, there is no assumption in the table that increases in investment are necessarily matched by proportional increases in impact. Nonetheless, the BP Working Group recognizes that NSF needs to consider activities of high investment; if such investments are deployed strategically, the impact is likely to be substantial relative to smaller investments.

Implicit in the activities summarized in this document and in the matrix is the commitment to balancing programmatic attention across groups. Underrepresented groups include women, African Americans, Latinos, Native Americans and Pacific Islanders, and disabled individuals. Across NSF, the broadening participation needs and historical emphases for different Directorates and programs vary widely. For example, the participation of women in the biological sciences has made substantial strides over the last two decades, whereas the participation of women in the physical sciences still lags behind desired goals. Another example is that, historically, NSF has sponsored programs explicitly addressing the needs of African American groups, whereas similar programs focusing explicitly on Latino groups have been lacking. All of the programs envisioned in this document have as their goal an even attention across underrepresented groups, as necessary for a given program. As you read through this document, please consider how the potential activities described could be profitably applied to address the broadening participation needs across all groups, not just one group or another.

Support Broadening Participation Activities that Vary in Level of Investment and Boldness

IdeaShare activities: NSF employees, those serving NSF on Intergovernmental Personnel Act assignments (IPAs) and Visiting Scientists are an excellent resource for ideas about NSF priorities and mechanisms for broadening participation. We should tap into this wealth of experience and hold one or several IdeaShare activities designed to generate ideas about investments of varying size in the broadening participation initiative. As the matrix on the previous page suggests, this activity would be low cost, but potentially high impact, insofar as it will engage the entire NSF workforce and potentially generate transformative ideas about how NSF should allocate its resources to broadening participation in the most effective manner. IdeaShare activities are straightforward to implement and action could be taken within the current fiscal year.

Welcome to IdeaShare

At the core of every good idea lives a spark of imagination ignited by a basic interest in making things better.

Welcome to IdeaShare! This is the place to share actionable ideas to make the Foundation the best it can be.

IdeaShare Challenge

Broadening Participation Best Practices

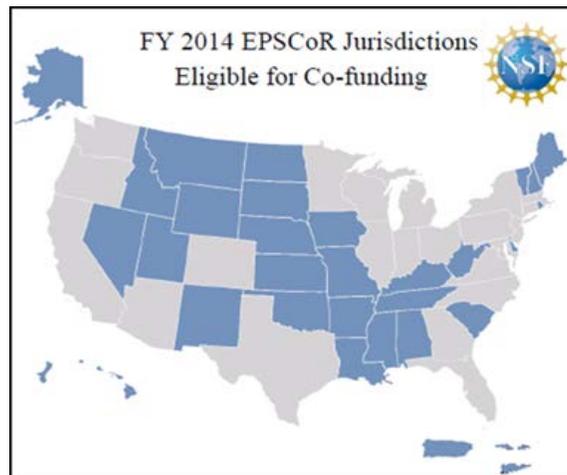
Broadening participation of underrepresented groups in the science and engineering enterprise is one of the cornerstones of the broader impacts review criteria that NSF uses to evaluate the degree to which a project is meritorious. We are seeking your input on examples of best practices that you have encountered in the proposals that you have reviewed or in the annual or final project reports that you have read. Please use this space to identify broadening participation best practices (BP2) that your PIs have done or have proposed to do that you feel are worthy of mention.

Use of community blogs: Blogs could serve as a reciprocal resource for NSF and the scientific communities. For example, NSF staff could start discussions of discipline-specific broadening participation challenges and opportunities on different online forums. Blogs could also serve to generate conversations with scientists and/or educators about cutting-edge findings related to the science of broadening participation, and how to best implement and scale up these best practices. This would also be low cost, but could have a high impact in terms of providing forums for dialogue and information-sharing between different stakeholders.

Community Design Projects: Community Design Projects are considered high risk but low investment and would essentially include awards that address local or regional broadening participation efforts such as the recent “Building Diverse Communities” effort of Experimental Program to Stimulate Competitive Research (EPSCoR) (Appendix B). These might include course and curriculum improvement, inclusion of culturally-relevant pedagogies, faculty development, and institutional capacity-building efforts. Additionally, proven strategies that have been shown to enhance recruitment, retention, engagement, and persistence in STEM such as bridge programs, cohort models, mentoring, and research experiences through internships and other mechanisms might also be explored such as the evidence-based best practices identified in the Opportunities for Enhancing Diversity in the Geosciences (OEDG) Portfolio (Appendix C). Research has also highlighted the importance of addressing campus climate and culture as a contributor to successful broadening participation efforts. These types of activities are already being funded in many NSF broadening participation focused and emphasis programs, but could be coordinated across the Foundation and focused on specific goals to increase the impact and avoid duplication. Coordinated community design projects could focus on replication of best practices that have been shown to support broadening participation in STEM at minority and majority institutions and efforts that solve accessibility challenges for STEM students with disabilities. Another strategy is to support projects that engage professional societies focused on diverse populations. An example of this kind of activity is given in Appendix D.

**EPSCoR Research Infrastructure Improvement Program Track-3:
Building Diverse Communities (RII Track-3 BDC)**

Experimental Program to Stimulate Competitive Research (EPSCoR) seeks to catalyze key research themes and related collaborative activities and to broaden participation in science and engineering by institutions, organizations, and people within and among EPSCoR jurisdictions. In FY 2013, EPSCoR solicited proposals to produce novel methods to broaden the participation of women, underrepresented groups, people with disabilities, and individuals from rural communities in STEM fields. With up to \$750K total for up to five years, projects in states ranging from Alaska to Louisiana were supported. A list of the projects and a short description can be found in Appendix B.



(EPSCoR Jurisdictions noted in dark blue color)

EPSCoR Jurisdictions Contain:

- 23% of nation's total population
- 27% of its research institutions
- 17% of its employed scientists and engineers
- 24% of nation's African Americans
- 40% of its American Indians and Alaskan Natives
- 49% of its Native Hawaiians and Pacific Islanders
- 16% of its Hispanics
- 52 of the nation's 105 HBCUs (50%)
- 74 of its 257 Institutions with High Hispanic Enrollment (29%)
- 22 of its 32 Tribal Colleges and Universities

Source: EPSCoR Brochure, 2014)

Opportunities for Enhancing Diversity in the GEOSCIENCES (OEDG) Program

<http://nsf.gov/geo/adgeo/education.jsp>

The goal of the OEDG-funded projects is to increase the participation of populations underrepresented in STEM in the geosciences. The review of 14 OEDG projects by the American Institutes for Research revealed 30 unique evidence-based best practices (e.g., research experience in the field or lab, mentoring, professional community, internships, etc.). Short descriptions of example projects are highlighted below. Longer descriptions, including assessment and evaluation results, can be found in Appendix C.

- *Ocean Leaders*, a collaborative project of the Ocean Discovery Institute and the University of San Diego, targets middle school, high school and undergraduate college students using marine ecology as a platform to diversify the geosciences.
- *Proyecto Dinosaurios*, housed at the Dinosaur Institute of the Natural History Museum of Los Angeles County, works with Hispanic students enrolled in local community colleges. The core strategy is an internship where community college students become immersed in all aspects of paleontological research and receive intensive mentoring while being paid to engage in research.
- SACNAS, the Society for Advancement of Chicanos and Native Americans in Science, is providing financial support for NSF Geoscience Scholars to attend the annual SACNAS conference and, while there, participate in a number of activities intended to contribute to their overall professional development and strengthen their commitment to careers in the geosciences. Mentoring is available at the conference from professional scientists.
- The WGBH Education Foundation received funding to engage Alaska Native students and their teachers with the Geosciences through a K-12 educational multimedia initiative. In addition to web-based resources for teachers (EAN--Engaging Alaska Natives in the Geosciences), the project included an online professional development course for teachers (Explore Alaska).
- The Environmental Reporting Fellowship (ERF) project, based in the University of Rhode Island's Metcalf Institute for Marine and Environmental Reporting, provided minority journalists with earth and environmental science training to better prepare them to report on science-based news with clarity, accuracy, and diverse perspectives.

An example of a community design program that has the potential to be translated into a broadening participation framework is the "Partnership for Undergraduate Life Sciences Education" (PULSE) activities spearheaded by the Directorate of Biological Sciences (BIO). This program, initiated in 2012, brings together university, college and community college campus leaders to share best practices on undergraduate education in biology and in changing the culture and values surrounding undergraduate teaching on campuses. The web site <<http://www.pulsecommunity.org/>> brings together a range of materials that can benefit the entire cohort of PULSE fellows, as well as the wider community. The program is too young to evaluate its impact but the model, which has been improved gradually through frequent workshops and regional meetings, seems promising for an initiative such as broadening participation. Efforts by NSF to improve access to STEM fields by underrepresented groups must be accompanied by systemic change on university campuses, and such change is likely to be achieved most swiftly and durably via campus leaders, such as those engaged in the PULSE program.

Another NSF activity whose aim is to engender systemic change at educational institutions is the “Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers” (ADVANCE) program (Appendix E). This program provides funding to “develop innovative and sustainable ways to promote gender equity in the STEM academic workforce”. Like the goals of broadening participation, ADVANCE focuses on promoting diversity at educational and research institutions by empowering campus leaders and cohorts of faculty and administrators. A version, or perhaps expansion, of ADVANCE that includes diverse types of underrepresented groups seems like an obvious and relatively low/medium risk activity.



Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)

ADVANCE Web Portal: www.advance-portal.net

The Institutional Transformation (IT) track of ADVANCE supports comprehensive, institution-wide projects at institutions of higher education to transform institutional practices and climate. This organizational approach was identified as an important strategy by NSF because research indicates that the lack of women’s full participation in science and engineering academic careers is often a systemic consequence of the academic culture and organizational structure of institutions of higher education. The following approaches are most effective when adapted to suit specific institutional contexts.

Institutional Structure: Universities and colleges often have organizational barriers that can negatively impact the participation of women and other underrepresented individuals in academic careers.

STRATEGIES

- Review, revise, and increase the transparency and effective implementation of policies and procedures (particularly recruitment, promotion, and tenure policies).
- Develop systematic and recurring institutional data collection and reporting of faculty data and climate surveys, disaggregated by demographics and rank, for use in decision-making.
- Incorporate equity and diversity responsibilities and accountability into institution-wide administrative positions, departmental leadership, and faculty to ensure equitable distribution of resources, responsibilities, and commitment.

Equitable Career Support: Career support programs, such as mentoring and leadership development, are important for retention and promotion of female and male faculty. Women are typically disadvantaged with respect to their male colleagues when career support activities are informal.

STRATEGIES

- Establish formal mentoring structures and provide recognition of service for the time and effort of mentors.
- Develop mechanisms to recognize professional excellence of both female and male faculty.
- Provide workshops, training, and coaching on the tenure and promotion processes to all faculty.
- Implement leadership development, career coaching, and network building programs.

Work-Life Support: Retention of both female and male faculty is closely related to satisfaction with work-life balance. Women are disproportionately impacted by work-life issues because female scientists and engineers are much more likely to have a dual-career partner in science and engineering than their male colleagues and because women continue to have a larger share of dependent-care responsibilities.

STRATEGIES

- Implement flexible career policies that address needs identified by the community.
- Develop career and life transition support programs.
- Establish dual-career hiring programs tailored to the institution and region.
- Encourage department and institutional flexibility and support for dependent-care responsibilities.
- Create institutional and departmental climates that encourage faculty to take advantage of work-life programs and ensure that there are no negative impacts on a faculty member’s career for participating in the programs.

Empowerment: Faculty, department leaders, and institutional administrators are empowered when introduced to the scholarly findings on gender equity barriers and given the tools and resources to address barriers in their decision-making.

STRATEGIES

- Provide faculty, department leaders, and institutional administrators with the tools and resources to address gender equity barriers.
- Provide training on effective strategies to reduce the stressors that result in a greater reliance on implicit biases when making decisions, especially in search committees and promotion and tenure committees.

(Read more in Appendix E)

It is with this in mind that we recommend that NSF expand on the successes and best practices learned from the ADVANCE program to offer a new opportunity to the academic research community. This new program, called **IDES** (Institutional Commitment to Leadership at Colleges and Universities to **INCREASE DIVERSITY** in **ENGINEERING** and **SCIENCE**) would have as its goal to develop systemic approaches and apply best practices in order to increase the representation of all groups that are underrepresented in both academic and non-academic STEM careers. Other important components of the **IDES** program are a contribution to research on broadening participation and a demonstrated institutional commitment to broadening participation at the institution.

Broadening Participation Institutes/Partnerships/Centers: High risk - medium investment options include Broadening Participation Centers that focus on building the knowledge base on broadening participation research, as well as augmenting the pool of scientists from underrepresented groups. The Directorate for Education and Human Resources (EHR) and the Directorate for Social, Behavioral and Economic Sciences (SBE) have issued Dear Colleague Letters, Stimulating Research Related to the Science of Broadening Participation (the most recent: NSF 14-038, Appendix F) in an effort to address the need for more research in this area and to provide evidence-based approaches to inform education, employment, and policy-making decisions. While some of NSF's existing research centers may already include broadening participation as a goal, this initiative calls for new centers to be created with broadening participation as the central mission and the foundation for all other activities. It is anticipated that these centers would have a higher education focus and address undergraduate, graduate, and post-doctoral training efforts which ensure that underrepresented minority scientists are supported throughout their education and training until they enter the STEM professional workforce. There is also a need to translate broadening participation research to practice, so that it can be integrated into scalable programs for widespread dissemination. The NSF Science of Learning Centers provide a good model and set of goals that might be used to inform similar centers focused exclusively on broadening participation: "The goals of the Science of Learning Centers Program are to advance the frontiers of all the sciences of learning through integrated research; to connect the research to specific scientific, technological, educational, and workforce challenges; to enable research communities to capitalize on new opportunities and discoveries; and to respond to new challenges."

Stimulating Research Related to the Science of Broadening Participation

The Directorate for Social, Behavioral, and Economic Sciences and the Directorate for Education and Human Resources have issued joint Dear Colleague Letters to stimulate research related to the science of broadening participation.

http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf14038

The Science of Broadening Participation employs the theories, methods, and analytic techniques of the social, behavioral, economic and learning sciences to better understand barriers that hinder and factors that enhance our ability to broaden participation in STEM. This includes supporting research that focuses on institutional, organizational, cultural, social, economic or policy-related factors that impact STEM participation and achievement rates.

The results of these efforts inform approaches to increase the access and involvement of underrepresented groups in STEM, and provide the scientific evidence that STEM educators, STEM employers, and policy-makers need to make informed decisions and to design effective programs and interventions.

(Read more in Appendix F)

DRAFT FOR DISCUSSION ONLY

IDES

Institutional Commitment to Leadership at Colleges and Universities to INCREASE DIVERSITY in Engineering and Science

The program would be modeled after the ADVANCE program with components of the Science and Technology Centers (STC) and other existing and successful programs throughout NSF and at other government agencies and at other private foundations.

For many decades, an increasing number of members of underrepresented groups (women, minorities and persons with disabilities) have obtained STEM advanced degrees, however, these scientists and engineers continue to be significantly underrepresented in almost all STEM academic positions. While the degree of underrepresentation varies among STEM disciplines, diversity in the senior professorial ranks and in many STEM careers and leadership roles in society is an issue in all fields. This underrepresentation is also a critical issue for the nation, at large, as the need to develop a globally competitive and diverse workforce increases.

The goal of the IDES program would be to develop systemic approaches (based on what is known to work (see Table 1)) to increase the representation and advancement of all groups that are underrepresented in both academic and non-academic STEM careers, thereby contributing to the development of a more diverse science and engineering workforce.

IDES also has as its goal to contribute to research and inform the general knowledge base on broadening participation in the academic STEM disciplines.

As a first step, institutions would be encouraged to implement programs and develop novel and innovative strategies that would lead to increased numbers of students from underrepresented groups receiving graduate degrees at their institutions and going on to careers in STEM. Recognizing that there is not a one size fits all approach, institutions would be encouraged to propose a number of approaches they would use and also demonstrate their commitment to broadening participation at their institution, based on the specific community that they are poised to serve. Demonstration that the institution is not only committed but also has implemented or plans to implement mechanisms and procedures for accountability will be part of the project description. Accountability is known to be an important piece of the puzzle when it comes to institutions that have already demonstrated success in not only retaining but also graduating students who go on for further advanced degrees and who eventually go on to careers in a STEM field.

Large-scale initiatives: The need for a robust STEM workforce has been reiterated in recent reports by the National Research Council (NRC), President’s Council of Advisors on Science and Technology (PCAST) and the National Science Board (NSB).^{3,4,5,6} These reports offer extensive recommendations for strategies that might be utilized to address the persistent disparities in racial, ethnic, and gender representation in STEM by strengthening K-12 education, increasing student interest and motivation in STEM, and increasing the number of underrepresented students successfully completing undergraduate STEM degree programs who wish to pursue STEM careers.^{4,5,6} Large scale, national initiatives that address the full spectrum of the educational trajectory, from prekindergarten to graduate school and beyond are considered bold activities requiring large investment. While this is an ambitious undertaking, it is critical for any national initiative to create appropriate public and private partnerships and include bold strategies that will have visible impact in the form of systemic changes. It is anticipated that by taking a systems approach, it may be possible to remove some of the barriers that are embedded in academic, social, and occupational systems that currently impede progress for underrepresented groups at all levels.

DRAFT FOR DISCUSSION ONLY

Large-Scale BP Initiatives: Possible Vision

The boldest of these outcomes would be to fully embrace the large-scale BP Centers that CEOSE recommends. These Centers would undertake research and large-scale implementation aimed at institutional and systemic change. They would work across the preK-20+ spectrum, fostering far-ranging partnerships that involve, for example, universities, community colleges, K-12 schools, informal learning providers, community groups, professional societies, industry supporters, and other BP centers.

Underrepresentation is a complex problem with subtle differences across underrepresented groups, the preK-20+ continuum, disciplines and institutions. There is no single Center infrastructure that could address this entire space. Instead, the NSF BP Centers will, in *aggregate*,

- Create, collect, vet, and disseminate research on underrepresentation and best and promising practices;
- Provide a locus for the development of a national academic research community focused on BP;
- Develop, test, and deploy BP interventions at scale;
- Inform and educate NSF and the broader science and engineering community on issues of underrepresentation and its remediation;
- Motivate and rally the broader science and engineering community to drive change;
- Provide a national distribution point/site for reforms that has strong channels to persons from the underrepresented groups; and
- Build public/private partnerships that promote inclusive practices within the preK-20 educational spectrum.

Finally the NSF BP Centers will be tightly integrated, sharing their infrastructure, resources, and expertise in order to form a comprehensive national network of support that allows all of our citizens to fully participate in the science and engineering enterprise.

Response to the Need for Diverse Approaches of Varying Scale to the Broadening Participation Initiative

Support for mid- and large-scale BP studies: The BP Working Group recognized that much new research needs to be conducted to better understand the determinants of persistence of underrepresented groups in STEM fields, and the types of interventions and programs that can help increase this persistence. NSF should support mid- and large-scale science of BP studies that help generate new protocols and interventions that can grow and sustain a healthy stream of underrepresented groups in STEM. Such studies might include longitudinal studies to track students receiving interventions or other support at various stages and comparison to control groups. Additionally, significant effort will need to be expended to better track the outcomes of the thousands of undergraduates, graduates students and postdocs to determine what effect NSF support had on their careers.

Each field of science supported by NSF has its own challenges with regard to broadening participation. Some studies supported in the broadening participation initiative will be relevant to NSF-wide programs, whereas other studies will be relevant to specific Directorates. It is important that each Directorate conducts some sort of study or self-assessment to clearly define its needs and to evaluate how well NSF-wide programs will meet those needs. Additionally, decisions as to how to leverage the capacities of ongoing programs (single PI grants, Centers, Research Coordination Networks) that could help conduct such studies will be required, and how these studies might be funded (through supplements, special solicitations, Dear Colleague Letters, etc.).

More replication of model BP programs: We actually know quite a bit about effective practices and interventions that lead to increased participation in STEM by underrepresented groups. In the last 5 years, a number of important studies (Walton & Cohen 2011; Yeager et al. 2013; Aguilar et al. 2014), as well as robust programs focusing on broadening participation in STEM, have appeared. These studies and ongoing programs provide powerful models for scaling up, because in many cases the studies have been replicated and we know they work under diverse conditions. While NSF should always foster innovation, we must be prepared to replicate and scale up best practices when positive outcomes are likely and shown to have worked in the past (See the CISE Investment in BP is making a difference in Appendix G).

The CISE Investment in Broadening Participation is Making a Difference

CISE funds 8 National Alliances that provide BP resources, develop, test and implement best practices, convene communities of researchers and practitioners, and call the CISE community to action. Examples:

- NCWIT (the National Center for Women and Information Technology)
NCWIT is a clearing house, resource center, spokes group, and a convener for the CS community. It houses an Academic Alliance (university departments), K-12 Alliance (teachers and faculty interested in CS K-12 education), Social Science Network (social scientists interested in research and evaluation on broadening participation in computing) , and Entrepreneurial Alliances, and an Industry Alliance.

Continued

- The Computer Science Equity Alliance

A collaboration between UCLA and the LA Unified School District (LAUSD) to introduce a new, introductory CS course, called Exploring Computer Science (ECS) into high schools. The course and its associated professional development focus on equity and inclusiveness.

- CDC/CRA-W (an Alliance between the Coalition to Diversify Computing and the Computing Research Association's Subcommittee on the Status of Women)

This Alliance focuses on mentoring for women from the undergraduate through the early career stages with the aim of building research careers. It's signature programs provide undergraduate research experiences for women (the CREU and DREU programs).

- AccessComputing

This Alliance engages individuals with disabilities as well as those who support, serve, guide, educate, and employ them in transformational efforts to make the computing disciplines more welcoming and accessible to individuals with disabilities, including post-9-11 veterans.

(Read more in Appendix G)

Examples of model programs in broadening participation include a number of programs at the University of Maryland Baltimore County, such as the Meyeroff Program, the LA-STEM program at Louisiana State University, the Biology Scholars Program at UC Berkeley and the Harvard Program for Research in Science and Engineering (PRISE), all of which have demonstrated tangible successes in improving persistence of underrepresented groups in STEM fields and achieving higher degrees in STEM (Koenig 2009). Such programs, particularly the UMBC work and the Louis Stokes Alliances for Minority Participation (LSAMP) program (Appendix H), are good models in part because they have clearly demonstrated improvement in various metrics, and often have baseline data with which to track the progress of interventions in detail. Although such programs can be expensive, NSF should explore the possibility of replicating such programs through a mechanism, or through special competitions. Replicating model practices outlined solely in published experimental studies may be more challenging, unless those practices have already been implemented systematically in ongoing programs at various institutions.

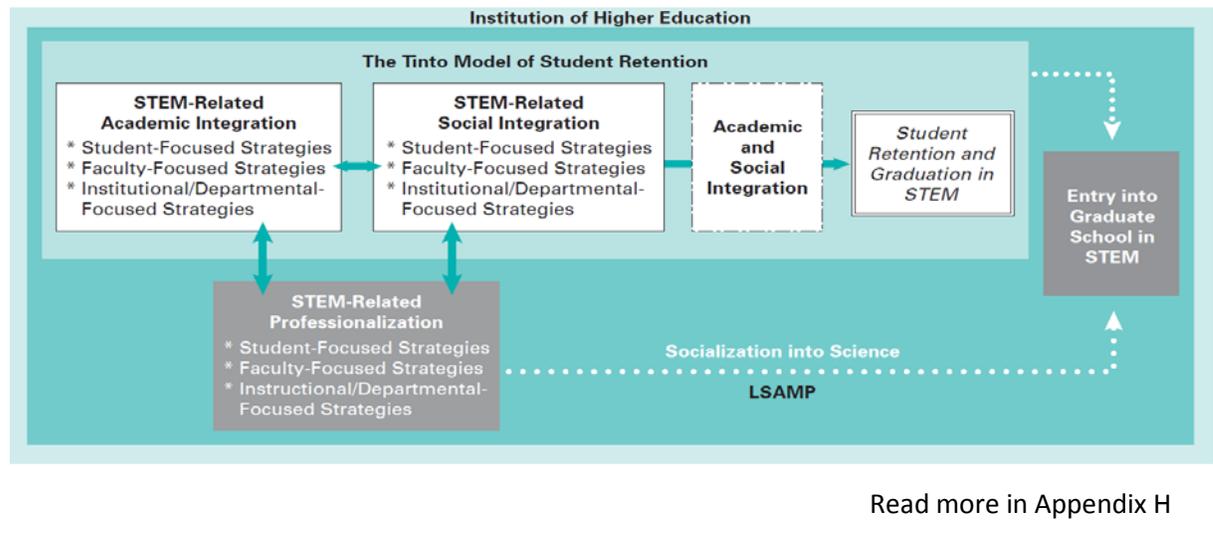
NSF Program: **Louis Stokes Alliance for Minority Participation (LSAMP)**

Goal: To develop strategies to increase the quality and quantity of minority students who successfully complete baccalaureate programs in STEM and continue on to graduate studies in these fields

Program Evaluation Report: **Revitalizing the Nation’s Talent Pool in STEM**

Urban Institute (<http://www.urban.org/url.cfm?ID=311299>)

Key Findings: About 80 percent of LSAMP graduates took further coursework after completing their bachelor’s degrees, compared with about 60 percent of comparison minority and non-minority BA holders. About 45 percent of former LSAMP students completed graduate degrees, while this was true of about 20 percent of national minority and white and Asian bachelor’s degree holders.

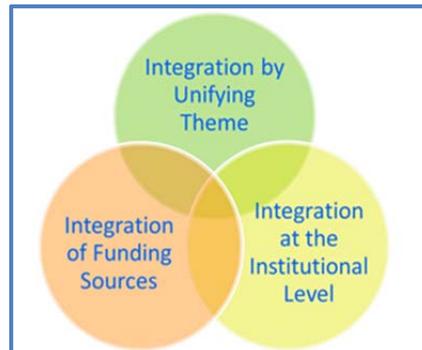
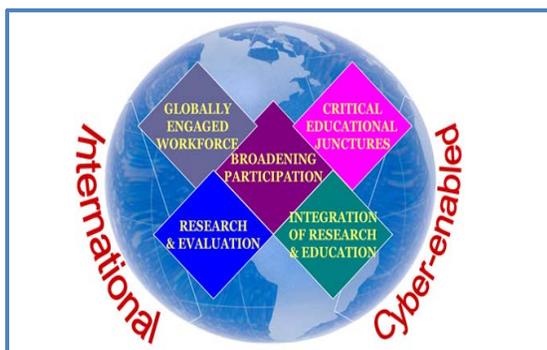


Leverage and expand programs with strong records of changing institutional culture and of broadening participation: Broadening participation in STEM will require not only a broad effort on the part of NSF-funded PIs and Centers, but also institutional change from leaders at universities, 2- and 4-year colleges, and community colleges. The Foundation’s Innovation through Institutional Integration activity supported approximately 30 awards that provided examples of effective practices and lessons learned (<http://nsf-i3.org/>) when administrators, faculty and others in institutions are challenged to think creatively and synergistically about innovation to strengthen human and institutional capacity in STEM disciplines, such that inter-institutional or intra-institutional efforts achieve value-added outcomes in broadening participation, seamless STEM pathways, and the integration of research and education (Appendix I).

NSF Activity: Innovation through Institutional Integration (I-Cubed or I³)
<http://nsf-i3.org/>

Goals: To increase synergy and collaboration across NSF-funded projects and within/between institutions, towards an educational environment where artificial boundaries are significantly reduced and the student experience is more fully integrated; to expand and deepen the impact of NSF-funded projects and enhance their sustainability. More details and examples given in Appendix I.

Theme	Primary	Secondary
Broadening Participation	41%	29%
Critical Junctures	25%	24%
Global Engagement	1%	10%
Integration of Research and Education	27%	25%
Research Only	6%	12%



NSF should inventory those programs that directly engage institutional leaders in the community to improve the environment and culture at their institutions to facilitate broadening participation. An example of such an NSF program is the Partnership for Undergraduate Life Science Education (PULSE) program. In this program, 40 PULSE Fellows from diverse institutions—mostly university administrators, deans, department chairs and scientific society representatives and community leaders – strategize about implementing best practices in undergraduate education, and how they plan to engage their communities to adopt those practices. The effort has been expanded to engage scientific societies and non-profit organizations. The same type of approach to implementing institutional change could be carried out for initiatives in broadening participation. The emphasis here could be on scaling up approaches in broadening participation that are proven, and educating faculty and stakeholders in these best practices, and rewarding their implementation. Similar efforts could be used to engage industry and the private sector relevant to STEM activities.

Many programs at NSF are well known to have made great strides in broadening participation (see NSF BP Portfolio in Appendix J). Examples include the Research Experiences for Undergraduates (REU) sites program, which brings together cohorts of students to the university to engage in research for usually 10-weeks in the summer, and the REU supplements, which provide such experiences on a smaller scale throughout the academic year. Different Directorates and Divisions treat broadening participation in the REU supplements with different levels of stringency, and NSF would benefit from a discussion about how to make these effective programs even more effective.

Supplemental funding: Supplemental funding is a major, low-risk mechanism by which NSF could augment its activities in broadening participation. Through DCLs and other means, NSF programs and Divisions could notify the PI community that increased emphasis on supplements will take place, and could outline a diversity of kinds of supplements that could be made. The particular demographic targets of supplements may vary by Directorate or Division, depending on the needs of the discipline. Examples of the types of activities that could be enabled and expanded through supplements include:

- Providing for summer research opportunities for underrepresented groups (REU);
- Providing for graduate student support for PIs with active NSF grants and who have identified a suitable candidate from an underrepresented group;
- Providing for postdoctoral support for PIs with active NSF grants and who have identified a suitable postdoctoral candidate from an underrepresented group;
- Providing funds for PIs or lab members to attend conferences focusing on diversity in science and engineering (such as Society for Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS), Annual Biomedical Research Conference for Minority Students (ABRCMS) and see others in Appendix K);
- Research Mentoring Grants, which could provide funds for research visits of individuals from underrepresented groups to labs currently funded by NSF;
- Research Coordination Networks to allow faculty to exchange best practices on broadening participation;
- Research Initiation Grants, to support the transition to faculty appointments of individuals from underrepresented groups.

One concern about supplemental activities that should be discussed further is that broadening participation efforts should not be relegated to supplemental activities, and that instead they should be at the core of any grant activity. Still, supplements may represent a mechanism that can be implemented quickly, and which could then be replaced by more systemic initiatives and funding mechanisms.

Provide Broadening Participation Policy and Communication Leadership

Activities internal to NSF: On the whole, NSF has a strong commitment to broadening participation activities. However, there are certainly things that can be done to increase awareness agency-wide and to facilitate efforts

by Program Officers to make a difference, both on a wide scale and on a more focused level in individual fields. These include:

- Identify strategic goals for broadening participation for NSF which address all directorates or subsets of directorates in order to meet the differing challenges of STEM sub-fields;

**Moving the Needle—Broadening Participation:
Suggested Priority Performance Goal and Strategic Objectives**

*Engage a diversity of perspectives and institutions in the advancement of
NSF priority areas for FY 2014-2018*

- Increase in the availability and dissemination of broadening participation information/research
 - Increase in institutional transformation through policies and practices focused on broadening participation
 - Increase in participation of members of underrepresented groups as panelists, reviewers, and awardees
 - Increase in representation of members of underrepresented groups employed as STEM program directors and in SES positions in STEM federal agencies
 - Increase in support of BP efforts through focused and emphasis programs and as part of the broader impacts of any NSF-funded projects
 - Increase in the number of students from URG receiving STEM financial support
 - Increase in precollege students from URG engaged in informal STEM experiences
 - Increase high school students from URG taking and succeeding in STEM courses
 - Increase in achievement of URG on national STEM assessments/tests/examinations
 - Increase in the representation of undergraduate and graduate underrepresented students majoring in STEM and attaining STEM degrees
 - Increase in the representation of STEM faculty at all ranks
 - Increase in the engagement of URG in innovation/frontier research and knowledge transfer
 - Encourage greater awareness of and emphasis on broadening participation activities among NSF Program Officers
 - Shift the mindset of faculty across the nation to envision broadening participation as an opportunity for creativity and as an integral component to their NSF-funded activities
- Increase the number of emphasis programs and other BP activities reaching the 50% threshold for the budget table reporting the NSF's fiscal investment in broadening participation;
 - Have Directorates and Divisions support more activities to broaden participation via Dear Colleague Letters. In this manner NSF gains the flexibility to target Directorate/Division specific goals while maintaining the overall NSF goals.

The Directorate of Biological Sciences (BIO) has established BP workshop policy and developed a tailored brochure, <http://www.nsf.gov/pubs/2014/nsf14085/nsf14085.pdf>, for BIO program officers to help promote broadening

participation when they attend scientific meetings. The brochure reminds the BIO community that broadening participation is an element of broader impacts. These activities, especially the policy statement, can be adapted NSF-wide or by other directorates.



**NATIONAL SCIENCE FOUNDATION
OFFICE OF THE ASSISTANT DIRECTOR
BIOLOGICAL SCIENCES
ARLINGTON, VIRGINIA 22230**

STAFF MEMORANDUM

BIO 12-01
(Replaces BIO 07-02)

October 16, 2012

GRANTS AND CONTRACTS

SUBJECT: Support of Conferences, Meetings, Workshops and International Congresses

This memorandum is a statement of BIO policy regarding the support of conference, meetings, workshops, and international congresses. It would be only under the most extenuating circumstances that BIO would support conferences, meetings, workshops, or international congresses that have no women and individuals from groups underrepresented in science on the program.

To ensure that barriers to full participation are examined and removed, BIO programs recommending awards for meetings that do not include women and individuals from groups underrepresented in science among the invited speakers must describe the actions taken by the Principal Investigator to identify qualified individuals and must provide an explanation for the omission. It will be the responsibility of the Division Director to monitor that this evaluation is completed.

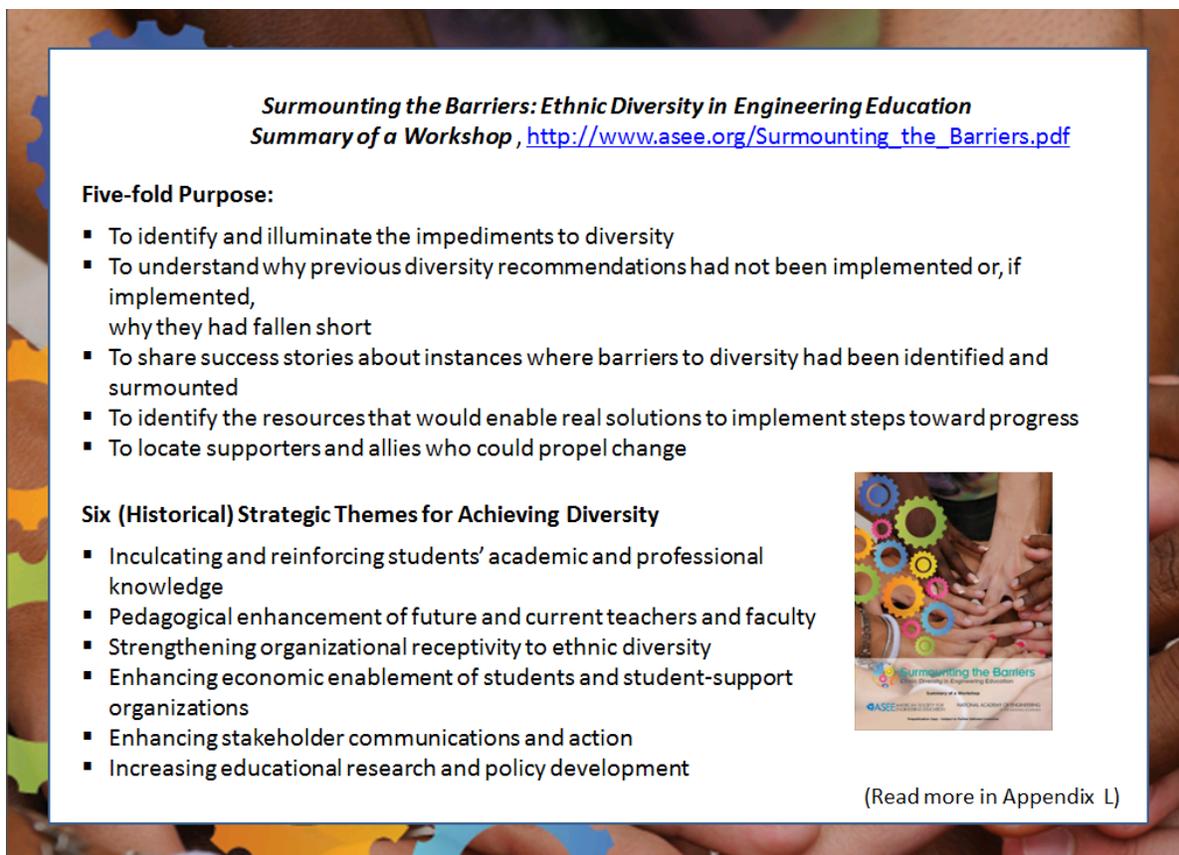
John C. Wingfield

John C. Wingfield
Assistant Director

E-Distribution: BIO – Entire Staff
NSF - SMART

Communication: Communication on issues of broadening participation should be a two-way street as reflected in the 2009 workshop report, [Workshop on Excellence by a Diverse Academic Workforce: Chemists, Chemical Engineers, and Material Scientists with Disabilities](#). NSF should make clear the importance that the agency places on broadening the participation of underrepresented groups in science. In return, the scientific community should

inform NSF of effective ways to address broadening participation in a variety of ways – general to STEM, specific to smaller scientific communities, and addressing particular subsets of underrepresented groups. A recent example is “*Surmounting the Barriers: Ethnic Diversity in Engineering Education*” (Appendix L).



Surmounting the Barriers: Ethnic Diversity in Engineering Education
Summary of a Workshop, http://www.asee.org/Surmounting_the_Barriers.pdf

Five-fold Purpose:

- To identify and illuminate the impediments to diversity
- To understand why previous diversity recommendations had not been implemented or, if implemented, why they had fallen short
- To share success stories about instances where barriers to diversity had been identified and surmounted
- To identify the resources that would enable real solutions to implement steps toward progress
- To locate supporters and allies who could propel change

Six (Historical) Strategic Themes for Achieving Diversity

- Inculcating and reinforcing students’ academic and professional knowledge
- Pedagogical enhancement of future and current teachers and faculty
- Strengthening organizational receptivity to ethnic diversity
- Enhancing economic enablement of students and student-support organizations
- Enhancing stakeholder communications and action
- Increasing educational research and policy development



(Read more in Appendix L)

NSF can foster two-way communication in different ways, including:

- Indicating the importance that NSF places on broadening participation through a general, highly visible notice to the community about broadening participation;
- Increasing the prominence of broadening participation language in the merit review criteria;
- Fostering and participating on community blogs to promote discussions of broadening participation in various communities;
- Enhancing the NSF broadening participation website with best practices and other resources, including providing demographic information by sub-field, as well as links to discipline specific resources;
- Increasing the prominence of broadening participation language in NSF solicitations, on the NSF website (not just the NSF broadening participation website, e.g. Directorate of Mathematical & Physical Sciences (MPS) Broadening Participation Resources, Appendix M), and via social media used by Office of Legislative & Public Affairs (OLPA);

- Educating reviewers and panelists about the importance of broadening participation in NSF projects, and the best practices that make such efforts effective. These scientists can then be effective ambassadors to the scientific community as a whole.

Coming Soon:
https://www.nsf.gov/mps/broadening_participation/index.jsp

MPS Broadening Participation Resources

NSF has a strong commitment to broadening participation. Groups underrepresented in MPS research include women, African Americans, Hispanic Americans, Native Americans, and persons with disabilities. The links below provide a sampling of information that may help Principal Investigators and others in broadening participation in their activities. This list is not meant to be exhaustive or to imply any special endorsement by MPS (or NSF).

Recruitment	RETENTION and MENTORING
<ul style="list-style-type: none"> ▪ NSB Report: The Science and Engineering Workforce - Realizing America's Potential 03-69 ▪ NSB Report on Broadening Participation 04-41 ▪ Race-Neutral Approaches to Diversity [student recruitment] ▪ (more on actual website) 	<ul style="list-style-type: none"> ▪ Preparing Women and Minorities for the IT Workforce [retention of students] ▪ Optimizing the Learning Environment for Students with Disabilities [including links to laws and other resources, broken down by disability type] ▪ (more on actual website)
RESOURCES	NETWORKS and ORGANIZATIONS
<ul style="list-style-type: none"> ▪ NSF Statistics: Science and Engineering Indicators ▪ Implicit Association Tests ▪ Diversity Myths and Realities ▪ (more on actual website) 	<ul style="list-style-type: none"> ▪ National Federation for the Blind (NFB) Learning Resources [includes link to NSF supported National Center for Blind Youth in Science]: ▪ Society for Advancement of Chicanos and Native Americans in Science (SACNAS) ▪ (more on actual website)
ACADEMIC INSTITUTIONS	
<ul style="list-style-type: none"> ▪ National Technical Institute for the Deaf ▪ PEPNet (Postsecondary Education Programs Network) [addresses needs of individuals with deafness, including those who are deaf with co-occurring disabilities] ▪ (more on actual website) 	

Section 4. Evidence-Based Interventions for Broadening Participation

There are many interventions that have proven to be successful for broadening participation at all levels, from K-12 to undergraduate and graduate students to faculty populations. Most of these interventions can be grouped into one or more of the following categories: financial support, professional/social support, combatting stereotype threat, community building, mentoring, and research experiences. Examples of some best practices are described in the literature and have been referenced in recent media stories, science journal articles and white papers (Bruno et al., 2014; Stassun et. al, 2010, Patel, 2014, Mervis, 2014a and 2014b); we highlight a few of these best practices below. While these examples are not all-inclusive, they do serve to illustrate what has been shown to work in programs already in place throughout the country.

Financial support is key to broadening participation. Underrepresented populations tend to be disproportionately from families with low socioeconomic status. At the precollege level, they often attend school systems that lack resources to sufficiently prepare them for higher education. As the cost of higher education continues to rise and free financial aid continues to decline, the result is that more and more students either cannot attend or require significant loans to complete their undergraduate degree. Providing financial support for students to pursue and attain their degrees is critical for broadening participation.

Providing professional support is another important component of broadening participation efforts. Lower income and/or underrepresented students often have not had the opportunity to develop a skillset that allows them to progress academically and professionally. These students need access to formal and informal activities that will provide them with the tools to excel; for example, workshops to develop skills such as public speaking and resume writing. In addition to professional support, providing different forms of social support to students is critical for broadening participation. Many students may feel isolated when they are far from home and their familiar surroundings. Programs such as the Sloan Indigenous Graduate Partnership Program provides support for students “...to pay for travel home for local ceremonies....and to create programs that can alleviate their sense of isolation on campus” (Patel, 2014). In addition, it has been found that pairing “like-minded students” who can work together (i.e. a buddy system) allows students from similar backgrounds to support each other, and therefore improves their chances of success (Bruno et al., 2014; Patel, 2014; Stassun, 2010).

To broaden participation, it is also important to combat stereotype threat. Stereotype threat can occur when one is afraid of confirming a negative stereotype about one's group (e.g., women aren't good at math). Academic contexts where the stereotype is made salient -- even in very subtle ways -- can have a negative effect on academic performance and lead to disengagement. Theoretically grounded interventions have mitigated some of these negative effects. For example, students told that intelligence can be developed with learning and effort (rather than viewing intelligence as "fixed") are less likely to demonstrate the negative effects of stereotype threat; having students affirm their self-worth in another domain can also reduce its consequences. These relatively easy to implement interventions have led to robust, sustainable improvements in academic performance and STEM retention (e.g., Cohen et al., 2006; Walton, 2014; Yeager et al., 2013).

Critical to the success of underrepresented minority (URM) populations, and most individuals is community building. “It takes a village” means that not only are many individuals involved in the development of our STEM workforce, they also represent a focused community with specific goals for success. This includes activities that

foster student retention such as one-on-one mentoring. Mentoring has the ability to shape lives. It also provides critical role models for the mentees, enabling them to see, not just the path forward, but also the destination. From undergraduate students mentoring high school students, to senior faculty mentoring early career faculty, this sharing of knowledge and insights can be transformative for the individual.

The importance of exposure to research cannot be over-emphasized, as these experiences can help initiate, develop, and maintain interest in STEM education and careers. The hands-on activity that sparks the 7th grade student to want to be a rocket scientist; the summer research experience that exposes a student to a state-of-the-art laboratory; the discussions with other researchers at professional conferences; these are the things that excite and encourage all of us to seek further knowledge and experiences (Bruno et al., 2014; Mervis, 2014b). Successful programs such as the Meyerhoff Scholars Program (see below), NSF's REU program, and partnerships between Minority-Serving Institutions and Research Intensive Universities are strong examples of how exposure to research can change student trajectories in STEM.

Institutional commitment is also critical for broadening participation efforts. To achieve specified goals, there must be measurable outcomes identified and accountability for reaching these outcomes. For example, STEM departments must be held accountable where credible evidence exists of bias, harassment, discrimination, and/or insufficient attention to equity or accessibility and accommodations. Institutional commitment and capacity building can be accomplished in several ways. A good model for this activity is the PULSE and ADVANCE programs in BIO and NSF-wide, respectively. The PULSE program engages university administrators and campus leaders to help change the culture at their respective institutions to better implement practices emphasized by the program Vision and Change in Undergraduate Biology Education (<http://visionandchange.org/>). The ADVANCE program works to change institutional practices and culture regarding support, promotion, and advancement of women faculty. Both of these programs recognize that implementing changes on university campuses, whether in education or in diversifying the workforce will require sustained engagement of campus faculty, staff and students by university leaders. Partnering with scientific societies is also a key approach in implementing culture change and advancing NSF goals. A major mechanism of NSF's activities in broadening participation should be to engage campus leaders across the country to build capacity, share best practices and change local culture.

Integrating many of these components into broadening participation programs may maximize successful results. For example, Howard Hughes Medical Institute (HHMI) Meyerhoff Scholars Program at the University of Maryland, Baltimore County (UMBC) is often considered a "gold standard" for providing a path into STEM fields for underrepresented minority and disadvantaged white students. The program, which includes "...scholarships, a summer bridge program for entering freshman, hands-on research experiences, and close monitoring of their academic performance with peer counseling and timely career advice" has been so successful that it is being replicated on other campuses and ongoing research is documenting the essential elements of its success (Mervis, 2014b). Through the I³ activity funded by NSF, UMBC is currently investigating the efficacies and efficiencies of four STEM intervention techniques used at UMBC to increase retention and graduation rates and enhance the educational experiences of all students in the STEM disciplines, particularly those from underrepresented groups. The four interventions are: 1) community-based study groups, 2) pro-active mentoring and ongoing retention risk assessment by high-status faculty, 3) pro-active mentoring and ongoing retention risk assessment by staff members, and 4) freshman active learning experience in CASTLE (the College of Natural and Mathematical Sciences-CNMS-Active Science teaching and Learning Environment). "This work investigates the assumption that

an essential approach for expanding participation and increasing retention/graduation rates is to identify the components of successful interventions that have the greatest impact at the lowest cost” (NSF, 2010).

Individuals and organizations worldwide are encouraged to replicate *DO-IT* ((Disabilities, Opportunities, Internetworking, and Technology) practices (<http://www.washington.edu/doi/Stem/promising.html>). The efforts that have led to increased participation in STEM include: support programs for students with disabilities such as residential study on a college campus, in-person and online peer and mentor support, internships and other work-based learning, and access to computers and assistive technology; the development and use of technology for people with disabilities; the practice of universal design of instruction, physical spaces, technology, and services; and strategies that bring about institutional change in addressing accommodation and technical resource needs, especially making STEM departments more welcoming and accessible to students with disabilities. In addition to mentoring, networking for the inclusion of persons with disabilities in professional opportunities is vital for retention and career development in STEM fields. The *Alliance for Access to Computing Careers*, for example, disseminates sustainable models for transitions of individuals with disabilities from high school to college, two-year to four-colleges, undergraduate to graduate programs, and military to college studies in computing (<http://www.washington.edu/accesscomputing/about-us/lessons-learned>). More recently, *ACCESS Engineering* (ECE-1444961) will be utilizing communities of practice, webinars, mini-grants, Capacity Building Institutes and an on-line clearinghouse to broaden the participation of persons with disabilities in engineering education and careers through nationwide engagement of faculty and students.

In addition to those already shared in this report, several programs throughout the Foundation have much to share about what works where, for whom, and in specific disciplines. A few more examples are in the Appendix N and it is expected that this starter set will be expanded and disseminated more widely via the NSF Broadening Participation webpage, as we continue our work with NSF Broadening Participation Point of Contacts and NSF leadership (Appendix O).

Section 5. Concluding Comments

The group consensus is that NSF should develop a multidimensional strategy that is responsive to the 2011-2012 CEOSE recommendation and demonstrates the core value of being broadly inclusive. This report (in response to the Charge found in Appendix P) has identified a broad range of activities to: accelerate a Foundation-wide engagement to achieve a diverse STEM workforce and enhance the Foundation's intellectual and financial commitments to broadening participation for societal benefits as well as the continuing advancement of scientific research and education frontiers. A knowledge-driven and evidence-based context should underpin the opportunities for innovations in broadening participation across and within disciplinary and interdisciplinary STEM portfolios. In addressing scale and scope, the strategic framework for the future should: address the diverse needs within the underrepresented groups and within scientific fields regarding participation and performance outcomes, leverage the integration of a core group of strategies that are successful across disciplinary boundaries regarding broadening participation, and explore new opportunities for collaborative models that address specific and shared broadening participation challenges. This multidimensional strategy will also need more creative means of measuring process and making claims of success for moving the broadening participation needle for all underrepresented groups: women, underrepresented racial/ethnic groups, and persons with disabilities. The NSF response to the call for a "bold new initiative" must be a focused effort resulting in new knowledge about participation in science and engineering, effective diversity practices for dissemination including scaling up, and partnerships for greater inclusive investments in STEM. NSF must continue its leading role in broadening participation, which is a key component of broader impacts, a core value of the agency, and a recommendation advocated by NSF advisory committees to help address complex scientific and societal challenges. We believe that collectively with the various STEM research and education communities that the Foundation can respond creatively to CEOSE's singular recommendation:

"... NSF should implement a bold new initiative, focused on broadening participation of underrepresented groups in STEM that emphasizes institutional transformation and system change; collects and makes accessible longitudinal data; defines clear benchmarks for success; supports the translation, replication and expansion of successful broadening participation efforts; and provides significant financial support to individuals who represent the very broadened participation that we seek."

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Appendix

- A CEOSE’s Call for a Synergistic, Pathway Approach and What NSF Has Supported
- B Building Diverse Communities
- C Opportunities for Enhancing Diversity in the GEOSCIENCE (OEDG) Program
- D Broadening Participation in Engineering
- E Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)
- F Stimulating Research Related to the Science of Broadening Participation
- G The CISE Investment in Broadening Participation is Making a Difference
- H Louis Stokes Alliance for Minority Participation (LSAMP)
- I NSF Activity: Innovation through Institutional Integration (I³)
- J NSF Programs to Broaden Participation FY2015 Request to Congress Budget Table and NSF Broadening Participation Portfolio
- K Conferences that Target Diversity in Science and Engineering
- L Surmounting the Barriers: Ethnic Diversity in Engineering Education
- M MPS Broadening Participation Resources
- N Programmatic Evidence of Results, Lessons Learned, Promising/Best Practices
- O NSF Broadening Participation Working Group List of Point of Contacts
- P NSF Broadening Participation Working Group Charge

CEOSE's Call for a Synergistic, Pathway Approach and What NSF Has Supported

CEOSE has asked the National Science Foundation to lead the nation in a bold effort to move from an incremental approach of addressing components of the underrepresentation challenge to an integrative approach that encapsulates all of the key concepts for a sustainability framework. This would entail scaling successful practices and transforming the STEM enterprise to be a seamless education and research system of excellence and global competitiveness for talent from all segments of the nation's STEM communities. The following display further outlines the details of the features and sub-components of the 2011-2012 CEOSE recommendation and the lessons learned from what is working across the NSF focused broadening participation investments (past and current focused programs and activities).

Across the years, NSF has employed an array of funding mechanisms to leverage best practices across the disciplines and to respond to the broadening participation recommendations of CEOSE and other national reports focused on advancing the development of all of the nation's talent in STEM. The following information is a preliminary synthesis of the calls for broadening participation efforts that science and engineering communities have responded to and demonstrated varying level of success with close attention to local and disciplinary challenges and opportunities. Collectively, NSF and its communities have engaged in best strategies and practices with approximately 10-12% of the annual NSF budget, resulting mostly in "incremental progress" at a low or moderate level for the underrepresented groups (women, historically underrepresented minorities, and people with disabilities). CEOSE agreed with the national consensus that now is the transformative moment 1) to expand opportunities to better serve underrepresented groups in STEM and do excellent science and 2) to disseminate more widely not just the inventory of BP programs but those approaches and practices that have been shown to be particularly effective through the preponderance of evidence of successful implementation within and across disciplinary boundaries and regions.

NSF-Supported Implementation Science Knowledge Base to Inform Raising the Bar and Moving the Needle for Broadening Participation

CEOSE-Recommended Features/Components	NSF’s Investment Examples (Current and Past Programs)
<p><u>Institutional and systemic change to address recruitment, progression, and advancement in the federal and academic STEM workforce</u></p>	<ul style="list-style-type: none"> ▪ Systemic Initiatives (i.e., USI and RSI) ▪ Innovation through Institutional Integration (I³) ▪ Increasing the Participation and Advancement of Women in Academic Science and Engineering (ADVANCE) ▪ Alliances for Graduate Education and the Professoriate (AGEP). ▪ Centers for Research Excellence in Science and Technology (CREST) ▪ Innovation through Institutional Integration (I³) ▪ Tribal Colleges and Universities (TCUP) ▪ Historically Black Colleges and Universities - Undergraduate Program (HBCU-UP)
<p>Proven Strategies that Work: Focused Programs</p>	
<p>Multiple NSF programs have been successful at implementing institutional and systemic change. Effective components of these programs include:</p> <ul style="list-style-type: none"> ▪ Investment and commitment from the institution's leadership (e.g., development of a vision and plan for leadership for broadening participation, establishing administrative offices or positions to support URM student success); ▪ Multi-year support; ▪ Engagement in transformative activities such as training, skills, and awareness building for STEM faculty, staff, and administrators and the development of innovative career opportunities for STEM students; ▪ Creation of strong partner alliances and campus networks to foster communication, dissemination, integrative activities, and career opportunities; ▪ Leveraging of existing NSF programs and resources; ▪ Targeted impact at many levels (STEM undergraduate and graduate programs, STEM students, STEM faculty). <p>It should be noted that this can occur with as little as \$500,000 to \$1 million per year to design and implement tailored models for institution-wide change (e.g., ADVANCE).</p>	
CEOSE-Recommended Features/Components	NSF’s Investment Examples (Current and Past Programs)
<p>Focus on interventions that are <u>scalable</u> (impact beyond institutions directly involved)</p>	<ul style="list-style-type: none"> ▪ Systemic Initiatives ▪ Research on Gender in Science and Engineering (GSE) ▪ EPSCoR’s Track 3, Building Diverse Communities ▪ Opportunities for Enhancing Diversity in the Geosciences (OEDG)

CEOSE-Recommended Features/Components	NSF's Investment Examples (Current and Past Programs)
	<p>Continued...</p> <ul style="list-style-type: none"> ▪ Increasing the Participation and Advancement of Women in Academic Science and Engineering (ADVANCE) ▪ Alliances for Graduate Education and the Professoriate (AGEP).
Proven Strategies that Work: Focused Programs	
<p>Once proof-of-concept evidence is established for materials, programs, and strategies, diffusion and scale up must become key activities. These programs listed above have served as an incubator for scalable projects that lead to widespread adoption of proven practices for broadening participation, with effects reaching:</p> <ul style="list-style-type: none"> ▪ Beyond single institutions/organizations through collaborative projects and electronic venues (e.g. GSE); ▪ Beyond EPSCoR jurisdictions through EPSCoR's education and diversity meetings and other dissemination efforts; ▪ Beyond national borders through best practices presentation at international meetings and/or posting of resources on public websites (e.g. ADVANCE, AGEP). 	
CEOSE-Recommended Features/Components	NSF's Investment Examples (Current and Past Programs)
<p>Integration of BP Research and Education</p>	<ul style="list-style-type: none"> ▪ Broadening Participation Research (BPR) track in BP Programs ▪ Science of Broadening Participation (SBP) ▪ Research in Disabilities Education (RDE) ▪ Broadening Participation Research Initiation Grants in Engineering (BRIGE) ▪ SBE Postdoctoral Research Fellowships (SPRF) ▪ Tribal Colleges and Universities Program (TCUP)
Proven Strategies that Work: Focused Programs	
<p>Many initiatives and core programs throughout the foundation are focused on increasing the corpus of research on the science of broadening participation, which in turn informs NSF-funded interventions and programs designed to reduce disparities in STEM fields. This has resulted in:</p> <ul style="list-style-type: none"> • Theoretically-grounded research using different methodologies that delineates the barriers that hinder and factors that enhance our ability to broaden participation in STEM, including an examination of institutional, organizational, cultural, social, economic and policy-related dimensions; • Research on the effectiveness of different interventions or strategies to improve retention of URM and women in STEM education and careers; 	

Proven Strategies that Work: Focused Programs (continued)	
<ul style="list-style-type: none"> • Incorporation of new models and innovations in STEM teaching and learning into evidence-based practices for broadening participation; • Development of uniquely tailored approaches targeting different underrepresented groups, educational contexts, and outcomes; • Integration of community goals and traditional knowledge with mainstream STEM education and research. 	
CEOSE-Recommended Features/Components	NSF's Investment Examples (Current and Past Programs)
<p><u>Longitudinal analysis to quantify success of BP efforts</u></p>	<ul style="list-style-type: none"> ▪ LSAMP Bridges to the Doctorate (BD) Activity ▪ Graduate Research Fellowship Program (GRFP) ▪ Increasing the Participation and Advancement of Women in Academic Science and Engineering (ADVANCE) ▪ Alliances for Graduate Education and the Professoriate (AGEP).
Proven Strategies that Work: Focused Programs	
<p>Longitudinal assessment of broadening participation funding has ensured that the impact of the program(s) on individuals or institutions can be quantified, and disaggregated by multiple characteristics (e.g., race, ethnicity, disability status, gender). Practices that have been successfully employed by NSF include the following.</p> <ul style="list-style-type: none"> ▪ Request three-year period of baseline data and contextual information about the institutions and organizations involved in an alliance prior to funding and annual reporting [beyond the funding period] to allow more meaningful evaluation of the impact of the institutional change approach. ▪ Collect demographic data and track the recipients receiving direct support during their educational training and into their careers. ▪ Support longitudinal studies 10-15 years after the start of the project. 	
CEOSE-Recommended Features/Components	NSF's Investment Examples (Current and Past Programs)
<p>Defined benchmarks for all aspects of broadening participation</p>	<ul style="list-style-type: none"> ▪ Programs with Annual Monitoring Systems (e.g., CREST, LSAMP, HBCU-UP) ▪ Programs requesting data submission with the proposal (e.g., ADVANCE, PREM) ▪ Projects focused on data collection for accountability (e.g., AGEF, I³)

Proven Strategies that Work: Focused Programs	
<p>NSF broadening participation programs typically require an evaluation plan that includes baseline data, benchmarks, and indicators of progress that assess implementation, outcomes and impact as part of the proposal submission. Additionally, this information is submitted annually in progress reports to NSF, ensuring the PI's accountability for qualitative and/or quantitative benchmark data.</p> <ul style="list-style-type: none"> ▪ When available, data should be part of the justification for support and the anticipated milestones should be outlined/detailed. ▪ Evaluation plans should include metrics that are specific to broadening participation issues/themes, noting differences by group and by discipline. ▪ The development and use of logic models and roadmaps will help facilitate the development of benchmarks/metrics and the assessment of progress. 	
CEOSE-Recommended Features/Components	NSF's Investment Examples (Current and Past Programs)
<p>Support for <u>translation, replication, & expansion</u> of what works to broaden participation</p>	<ul style="list-style-type: none"> ▪ ADVANCE Partnerships for Adaptation, Implementation, and Dissemination (PAID) ▪ Broadening Participation Research Unitation Grants in Engineering (BRIGE) ▪ Research in Disabilities Education (RDE) ▪ Research on Gender in Science and Engineering (GSE)
Proven Strategies that Work: Focused Programs	
<p>NSF-funded broadening participation programs require plans for dissemination and replication; this can be achieved through different means, including collaborative partnerships, providing training on adopting and/or adapting resources and information, or other mechanisms for training, implementation, and adoption of evidence-based approaches for broadening participation. Grantees have responded favorably to the following conditions.</p> <ul style="list-style-type: none"> ▪ Materials, tools, and practices to be disseminated must have demonstrated effectiveness in increasing the participation and/or advancement of URG in STEM careers; effective dissemination of products and practices involves efforts to provide training on how to adopt or adapt the resources/information (e.g. ADVANCE). ▪ Model building projects must have a strong theoretical base for creating, implementing, translating and replicating innovative educational and institutional capacity building models (e.g. RDE). ▪ Extension services awards offer proactive training, consulting, implementation assistance, and reporting on experience to the field, serving as conduit for understanding research findings and for adoption of research-based approaches to broadening participation as well as communicating to researchers the problems that practicing educators find most urgent or troublesome in adopting new methods or tools (e.g. GSE). 	

CEOSE-Recommended Features/Components	NSF's Investment Examples (Current and Past Programs)
<p>Coordination of research centers and projects from PreK-20+</p>	<ul style="list-style-type: none"> ▪ Systemic Initiatives (STEM Teaching Workforce) ▪ Centers (Education and Outreach) ▪ EPSCOR Research Infrastructure Improvement Program Track- 3: Building Diverse Communities (RII Track 3) ▪ Partnerships for Research and Education in Materials (PREM) ▪ Research on Gender in Science and Engineering (GSE) ▪ Tribal Colleges and Universities (TCUP)
<p>Proven Strategies that Work: Focused Programs</p>	
<p>Many NSF programs include the development of partnerships with K-12 schools, communities, tribal government units, and other relevant groups; many programs target critical times of transition in educational trajectories (e.g., between high school and college). For example, the systemic reform initiatives demonstrated varying levels of success in establishing large-scale partnerships that were organized around the following drivers of K-12 systemic reform:</p> <ul style="list-style-type: none"> ▪ Driver 1: Rigorous, standards-based instruction for all students, and the curriculum, professional development, and assessment systems to support that instruction. ▪ Driver 2: A unified set of policies that facilitate and enable driver 1. ▪ Driver 3: A unified application of all resources to facilitate and enable driver 1. ▪ Driver 4: Mobilization of the full community of stakeholders. ▪ Driver 5: Increased student attainment in science, mathematics, and technology. ▪ Driver 6: Reduction in attainment differences between those traditionally underserved and their peers. (National Science Foundation, n.d.) <p>Additionally, NSF has supported efforts that have delivered the following critical components of and design principles for higher education investment in broadening participation: institutional leadership, inclusive recruitment, summer bridge program/bridging to the next level, peer support, research and other professional opportunities, mentoring, drop-in center for academic and/or psychosocial support, engaged faculty/caring staff, financial support, and continuous evaluation.</p>	
CEOSE-Recommended Features/Components	NSF's Investment Examples (Current and Past Programs)
<p>Direct financial support</p>	<ul style="list-style-type: none"> ▪ Alliance for Graduate Education and the Professoriate (AGEP) ▪ Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) ▪ Louis Stokes Alliances for Minority Participation (LSAMP) - Bridge to the Doctorate (BD) Activity ▪ Ocean Science Postdoctoral Research Fellowships (OCE-PRF) ▪ Postdoctoral Research Fellowships in Biology (PRFB) ▪ Ocean Science Research Initiation Grants (OCE-RIG) ▪ SBE Postdoctoral Research Fellowships (SPRF)

Proven Strategies that Work: Focused Programs	
<p>Direct financial support in transformation projects should be allowed for stipends, scholarships, fellowships, recruitment bonuses, retention bonuses, and tuition and fees. Direct support provided to URGs must be equitable with similar students and postdoctoral scholars and care should be taken to ensure that support does not isolate or otherwise negatively impact the recipients. NSF programs for broadening participation have provided direct support for:</p> <ul style="list-style-type: none"> • Stipends, scholarships, and tuition support for underrepresented minority graduate students (AGEP; LSAMP Bridge to the Doctorate); • Postdoctoral fellowships (OCE-PRF; SPRF; PRFB); • Faculty at HBCUs (HBCU-UP) or underrepresented early career faculty (OCE-RIG) to facilitate their research. 	
CEOSE-Recommended Features/Components	NSF’s Investment Examples (Current and Past Programs)
<p>Interagency/private sector partnerships</p>	<ul style="list-style-type: none"> ▪ Alliances for Graduate Education and the Professoriate (AGEP) ▪ Centers of Research Excellence in Science and Technology (CREST) ▪ Historically Black Colleges and Universities – Undergraduate Program (HBCU-UP) ▪ Opportunities for Enhancing Diversity in the Geosciences (OEDG)
Proven Strategies that Work: Focused Programs	
<p>NSF does encourage innovation and commitment to/recognition of excellence for broadening participation through public-private partnerships. For example, <i>Achieving Competitive Excellence</i> grants may include: new collaborations and alliance with public and private research institutions, centers, and national laboratories; providing access to tomorrow’s science through computationally intensive tools and global networks; establishing international collaborations to enhance undergraduate student and faculty research; or increasing fiscal resources for frontier STEM education and research through innovative institutional integration, leveraging partnerships, and strong linkages with business and industry (HBCU-UP). All organizational units have funded public-private collaborative projects that aim to implement new strategies or replicate proven models to broaden participation.</p> <p>NSF programs have facilitated collaborative partnerships between research institutions and:</p> <ul style="list-style-type: none"> • The private sector; • Educational leaders and other experts; • Research centers and national laboratories; • Community colleges and school systems; • Government agencies; • Professional STEM organizations. 	

CEOSE-Recommended Features/Components	NSF's Investment Examples (Current and Past Programs)
<p>Long-term commitment of resources</p>	<ul style="list-style-type: none"> ▪ Alliances (e.g., AGEP, LSAMP) ▪ Centers (e.g., CREST) ▪ Partnerships (e.g., Partnerships in Astronomy & Astrophysics Research and Education – PAARE) ▪ RDE
<p>Proven Strategies that Work: Focused Programs</p>	
<p>Long-term commitment of resources is needed for the development, implementation, study and dissemination of innovative models. The readiness of a community has to be considered in strategizing how to be impactful short-and long-term. For example, in the RDE portfolio model building level one provided support for designing, developing, and testing models, whereas model building level two provided support for replicating, translating, and implement models in a different institutional context/setting.</p> <p>NSF programs have different mechanisms for securing long-term commitment of resources, including:</p> <ul style="list-style-type: none"> ▪ Renewals for additional years of funding based on demonstrated success in BP and institutional transformation; ▪ Expectations that PIs develop sustainability plans to continue the project goals without NSF funding; ▪ Development of partnerships between Minority-Serving Institutions and other academic institutions and scientific facilities. 	

The key observation is that for any particular strategic component or for each of the programmatic efforts, the growing need of broadening participation (BP) in the changing landscape of the scientific enterprise is creating a talent challenge that is “outstripping the resources.” This is the reason for CEOSE’s call for a bold new initiative that is asking the NSF to be integrative and strategic to ensure a greater return on the investment for infrastructure change and evidence of sustained institutional diversity in STEM for all types of institutions. CEOSE is recommending that the Foundation take the risk of a large-scale investment that is inclusive of all the above strategies that do work for underrepresented groups in STEM. This game changer will require better coordination of what is being implemented at an institution so that the additional BP support is leveraged to engage broad partnerships to counter barriers and fill the opportunity gaps, yielding inclusive systems of change that solve the “underrepresentation problem” of STEM for the current and next generation of the science and engineering workforce. NSF can help ensure that each disciplinary and interdisciplinary field offers a tailored set of ten elements in focused and strategic efforts (through supplements, new tracks, and/or a new large-scale initiative) to produce a more diverse STEM workforce to advance discovery and innovation.

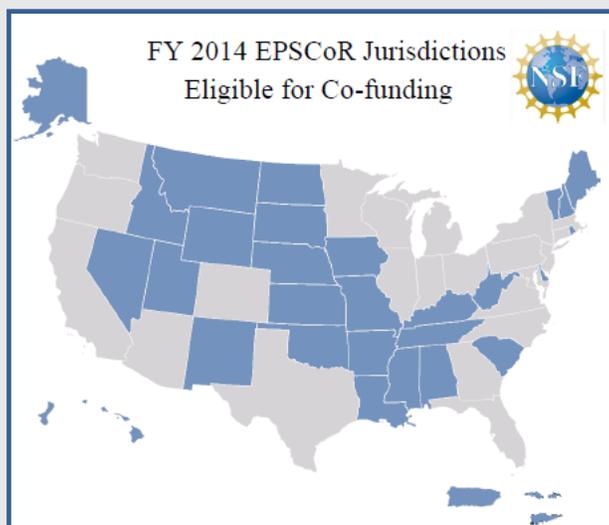
In short, the “bold BP partnerships” would make a collective impact through the synergy and advancement of coordinated requirements of new policies, effective practices for inclusive participation, and increased performance accountability.

Policies	Practices	Performance
<ul style="list-style-type: none"> ▪ Long-Term Commitment of Resources ▪ Interagency/Private Sector Partnerships 	<ul style="list-style-type: none"> ▪ Integration of BP Research and Education ▪ PK-20+ Coordination ▪ Direct Financial Support ▪ Translation, Replication, Expansion ▪ Scalable 	<ul style="list-style-type: none"> ▪ Defined Benchmarks ▪ Longitudinal Analysis ▪ Institutional and Systemic Change

Research Infrastructure Improvement Track 3: Building Diverse Communities

Experimental Program to Stimulate Competitive Research (EPSCoR) seeks to catalyze key research themes and related collaborative activities and to broaden participation in science and engineering by institutions, organizations, and people within and among EPSCoR jurisdictions. In FY 2013, EPSCoR solicited proposals to produce novel methods to broaden the participation of women, underrepresented groups, people with disabilities, and individuals from rural communities in STEM fields. With up to \$750K total for up to five years, the following projects were initiated in FY13 and FY14:

- Maine – Engineering innovative solutions to storm-water problems through Native American and high school student participation
- New Hampshire – Partnership to build access to relevant computing education for underrepresented minority high school students through teacher professional development
- Nebraska – Developing two-semester chemistry course sequence for Tribal College that is culturally-rich with real-life applications that have meaning to the Native American community
- Nevada—Testing of a cyber-learning methodology to elevate STEM learning opportunities and promote success for underrepresented minority and rural middle school students
- Kentucky—Conducting camps and clubs to stimulate interest in STEM fields among females and students of color in grades five through eight
- Alaska—Engaging underserved students in STEM fields through hands-on activities working with unmanned aerial vehicles to understand the environment
- Louisiana—Partnering with LA high schools to test a model of empowering underrepresented minority students and teachers through project-based learning by immersion in content focused camps and design project competitions
- Arkansas—Applying a modified from the Fisk-Vanderbilt masters-to-PhD Bridge Program to test it validity, among rural, distal institutions in AR to increase underrepresented minority student participation in graduate-level STEM programs
- Alabama—Investigating rural secondary school teachers’ motivation and ability to lead their economically disadvantaged students from underrepresented minority groups in science fair projects and develop a long-term appreciation for the effectiveness of inquiry-based learning
- Idaho—Creating a regional Native American Network graduate program with interdisciplinary courses that combine traditional knowledge and western sciences indigenous program for STEM research and a regional Native Network of Graduate Education



EPSCoR Jurisdictions Contain:

- 23% of nation’s total population
- 27% of its research institutions
- 17% of its employed scientists and engineers
- 24% of nation’s African Americans
- 40% of its American Indians and Alaskan Natives
- 49% of its Native Hawaiians and Pacific Islanders
- 16% of its Hispanics
- 52 of the nation’s 105 HBCUs (50%)
- 74 of its 257 institutions with high Hispanic enrollment (29%)
- 22 of its 32 Tribal Colleges and Universities (69%)

Opportunities for Enhancing Diversity in the GEOSCIENCES (OEDG) Program

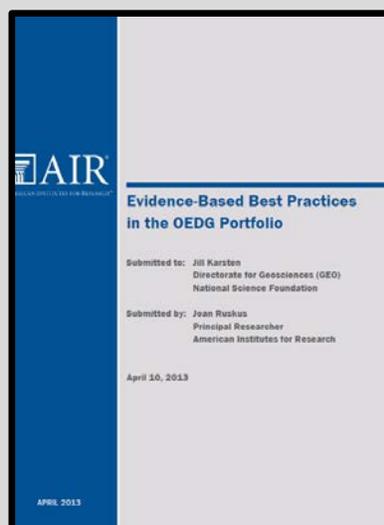
<http://nsf.gov/geo/adgeo/education.jsp>

The goal of the OEDG-funded projects is to increase the participation of populations underrepresented in STEM in the geosciences. The review of 14 OEDG projects by the American Institutes for Research revealed 30 unique evidence-based best practices (e.g., research experience in the field or lab, mentoring, professional community, internships, etc.). Examples of projects are highlighted below.

- *Ocean Leaders*, a collaborative project of the Ocean Discovery Institute and the University of San Diego, targets middle school, high school and undergraduate college students using marine ecology as a platform to diversify the geosciences. The philosophy is to target the entire urban community, serving approximately 5,000 students a year in school-based initiatives. The *Ocean Leaders* high school research program is an annual 18-week summer experience, where the following criteria are considered in the selection of participants: curiosity, resilience, perseverance, and interpersonal skills. Results have indicated that students have increased their performance on objective science tests and that of the program participants now enrolled in four-year universities who have declared a major, 73 percent (22 of 30) selected a major in the fields of science or conservation. Additionally, work is underway to replicate the Ocean Leaders model in the District of Columbia using NOAA Funds for planning and initial stage.
- *Proyecto Dinosaurios*, housed at the Dinosaur Institute of the Natural History Museum of Los Angeles County, works with Hispanic student enrolled in local community colleges. The core strategy is an internship where community college students become immersed in all aspects of paleontological research and receive intensive mentoring while being paid to engage in research. Throughout the year, the student participants work closely with researchers at the Dinosaur Institute in an employment-like arrangement. Qualitative data revealed that students developed a more sophisticated understanding of key geosciences and came to recognize scientists as “normal” people and colleague within a larger community. Two of the four Track 1 program participants are employed in STEM careers and three of four Track 2 program participants are majoring in STEM fields. All students attributed their increased interest in the sciences and their expanded understanding of the opportunities available to them to their experiences in *Proyecto Dinosaurios*.
- SACNAS, the Society for Advancement of Chicanos and Native Americans in Science, is providing financial support for NSF Geoscience Scholars to attend the annual SACNAS conference and, while there, participate in a number of activities intended to contribute to their overall professional development and strengthen their commitment to careers in the geosciences. Mentoring is available at the conference from professional scientists. Also, at least half of the scholars attending the conference present their research results. The reaction of Geoscience scholars to the conference experience was quite positive with high percentages of agreement for the conference support for professional development (93%) and acquiring valuable knowledge and skills (98%). The average Geoscience Scholar met between four and five mentors at the annual conference and a six-month follow-up showed that the scholars were graduating with STEM degrees or still pursuing a degree in a geoscience discipline.

Continued

- The WGBH Education Foundation receiving funding to engage Alaska Native students and their teachers with the Geosciences through a K-12 educational multimedia initiative. In addition to web-based resources for teachers (EAN--Engaging Alaska Natives in the Geosciences), the project included an online professional development course for teacher (Explore Alaska). Evaluation results from 2010 indicated that the EAN special collection received more than 37,000 visits worldwide; of these nearly 29,000 were in the U.S. and over 1,760 were from Alaska. Through June 2011, the resources have been visited more than 70,000 times. The online professional development course, Explore Alaska, was approved by the Alaska Pacific University as a 500-level professional development class that can be used for teacher re-certification
- The Environmental Reporting Fellowship (ERF) project, based in the University of Rhode Island's Metcalf Institute for Marine and Environmental Reporting, provided minority journalists with earth and environmental science training to better prepare them to report on science-based news with clarity, accuracy, and diverse perspectives. The training involved a 1 ½ -day orientation by the Graduate School of Oceanography, a three-day science immersion workshop on environmental justice, one month of independent study with the guidance of a science mentor, and a nine-month environmental reporting assignment in a media outlet under the guidance of a media mentor. A total of 19 early-career journalists of color served as Fellows and were paid approximately \$29,000 for this 10-month experience. The data indicated that Fellows developed greater confidence in their abilities to research and understand scientific studies over the course of the fellowship. The results of the follow-up survey in 2011 revealed that 12 of the 15 who responded were still working in journalism and 91 percent still found ways to work science and the environment into their reporting. Additionally, it was found that 26 percent of the Fellows are still contributing stories to their ERF host outlets, up to six years after their fellowships ended.



Broadening Participation in Engineering

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504870

Goal: The Broadening Participation in Engineering (BPE) Program is a Directorate-wide activity to support the development of a diverse and well-prepared workforce of engineering graduates, particularly those with advanced degrees. The BPE Program supports projects to engage and develop diverse teams that can offer unique perspectives and insights to challenges in engineering research and education.

Strategies:

- Engage Professional Engineering Societies focused on Diverse Populations
- Support Research that addresses
 - the understanding of how a diverse engineering student body, professional workforce, and faculty impact engineering innovation and productivity.
 - the underlying issues affecting the differential participation rates in engineering, particularly those that can be addressed by engineering faculty members.
 - the experiences and interactions that enhance or inhibit underrepresented groups' persistence to degree and career interest in the professoriate.

Examples:

The University of Michigan is exploring whether college admissions files can be structured to improve the decision making of admissions officers. Psychological biases may hinder the ability of admissions officers to make ideal decisions, which could lead to the rejection of well-qualified low-income and minority students. This experimental study will examine whether changing the information included with the application, along with the order in which that information appears, will affect admissions officers' decisions about which applications to accept.

NACME (National Action Council for Minorities in Engineering) is investigating minority engineering programs at multiple institutions to establish promising practices for increasing minority student graduation rates. Although the selected 25 institutions confer one third of the nation's minority engineering degrees, there has been no comprehensive study that takes an empirical look at how this level of success is achieved, nor one that documents the practices that account for it.

AISES (American Indian Science and Engineering Society) is developing a virtual mentoring network to support American Indian students and faculty. This award to AISES is aimed at increasing the number of American Indian and Alaska Native (AI/AN) students who persist in science, technology, engineering and mathematics (STEM). The long term goal is to increase the number of AI/AN individuals who pursue faculty positions in STEM disciplines at US colleges and universities. This award is funded across multiple Directorates.

The Engineering Research Centers (ERCs) have expanded their diversity efforts with each new generation of Centers from requiring research experiences for teachers focused on diversity to requiring diversity strategic plans to the requirement that third generation ERCs have a lead or core partner that must be an MSI/HSI/HBCU. In 2008 North Carolina A&T State University became the first HBCU to lead an ERC.

Program Name: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)

ADVANCE Web Portal: www.advance-portal.net

Goals: Institutional Transformation (IT) supports comprehensive, institution-wide projects at institutions of higher education to transform institutional practices and climate. This organizational approach was identified as an important strategy by NSF because research indicates that the lack of women's full participation in science and engineering academic careers is often a systemic consequence of the academic culture and organizational structure of institutions of higher education.

The following approaches are most effective when adapted to suit specific institutional contexts.

Institutional Structure: Universities and colleges often have organizational barriers that can negatively impact the participation of women and other underrepresented individuals in academic careers.

STRATEGIES

- Review, revise, and increase the transparency and effective implementation of policies and procedures (particularly recruitment, promotion, and tenure policies).
- Develop systematic and recurring institutional data collection and reporting of faculty data and climate surveys, disaggregated by demographics and rank, for use in decision making.
- Incorporate equity and diversity responsibilities and accountability into institution wide administrative positions, departmental leadership, and faculty to ensure equitable distribution of resources, responsibilities, and commitment.

Work-Life Support: Retention of both female and male faculty is closely related to satisfaction with work-life balance. Women are disproportionately impacted by work-life issues because female scientists and engineers are much more likely to have a dual career partner in science and engineering than their male colleagues and because women continue to have a larger share of dependent care responsibilities.

STRATEGIES

- Implement flexible career policies that address needs identified by the community.
- Develop career and life transition support programs.
- Establish dual career hiring programs tailored to the institution and region.
- Encourage department and institutional flexibility and support for dependent care responsibilities.
- Create institutional and departmental climates that encourage faculty to take advantage of work-life programs and ensure that there are no negative impacts on a faculty member's career for participating in the programs.

Equitable Career Support: Career support programs, such as mentoring and leadership development, are important for retention and promotion of female and male faculty. Women are typically disadvantaged with respect to their male colleagues when career support activities are informal.

STRATEGIES

- Establish formal mentoring structures and provide recognition of service for the time and effort of mentors.
- Develop mechanisms to recognize professional excellence of both female and male faculty.
- Provide workshops, training, and coaching on the tenure and promotion processes to all faculties.
- Implement leadership development, career coaching, and network building programs.

Empowerment: Faculty, department leaders, and institutional administrators are empowered when introduced to the scholarly findings on gender equity barriers and given the tools and resources to address barriers in their decision making.

STRATEGIES

- Provide faculty, department leaders, and institutional administrators with the tools and resources to address gender equity barriers.
- Provide training on effective strategies to reduce the stressors that result in a greater reliance on implicit biases when making decisions, especially in search committees and promotion and tenure committees.

Background

The goal of the National Science Foundation's (NSF) ADVANCE program is to increase the representation and advancement of women in academic science and engineering careers, thereby developing a more diverse science and engineering workforce. ADVANCE encourages institutions of higher education and the broader science, technology, engineering, and mathematics (STEM) community, including professional societies and other STEM related, not for profit organizations, to address various aspects of STEM academic culture and institutional structure that may differentially affect women faculty and academic administrators. As such, ADVANCE is an integral part of the NSF's multifaceted strategy to broaden participation in the STEM workforce, and it supports the critical role of the Foundation in advancing the status of women in STEM academic careers.

Steps Toward Transformation

Since 2001, ADVANCE Institutional Transformation awardees have developed an understanding of the steps needed to create a more equitable environment for women faculty. Many of these steps can be incorporated into ongoing strategic planning efforts and implemented by existing institutional offices and administrative positions. In order to be successful and sustainable, these activities should involve the institutional leadership, midlevel administrators, and faculty.

Review the Research: Study the social science literature on organizational change, implicit and explicit bias, work-life issues, accumulated disadvantage, and other research related to the underrepresentation of women in STEM academic careers.

Collect and Analyze the Data: Identify the specific needs of faculty via surveys and consultation and gather basic institutional data, such as, but not limited to:

1. The distribution of faculty by gender, minority status, disability, tenure status, rank, and department.
2. The outcomes of recruitment, retention, and advancement by gender.
3. The gender distribution of STEM faculty in leadership positions.
4. The allocation of resources and opportunities for STEM faculty by gender.

Review and Revise Policies, Procedures, and Practices: Identify and review the relevant institutional and departmental policies, procedures, and practices that impact academic careers, such as recruitment, tenure, and promotion. Consider that many institutional practices are often not written down (e.g., recruiting faculty from a limited set of institutions), but can have significant impact on decisions and may differentially affect various demographic groups. Revise and clarify problematic or vague policies and practices and ensure that the policies and practices are consistently applied.

Adapt and Innovate Strategies: Research existing strategies that support faculty and identify ways to adapt them to the institutional context. New and innovative strategies may be needed, particularly to address challenges that are unique due to institution type, institutional mission, and geographic region. All strategies should be supported by the available literature and justified with the institutional data and outcomes of the policy, procedure, and practice review. New programs should be built into existing institutional offices and administrative positions whenever possible.

Keep the Institution Informed: Report the institutional data and the outcomes of the policy, procedure, and practice review and the resulting revisions.

Monitor and Revise: Monitor faculty policies and programs over time to evaluate the impact of changes and revisions. Institutional data, including the use of and attitudes about new and revised policies and programs, should be collected and analyzed on a regular basis in order to identify new issues and address areas that still need attention.

Source: [ADVANCE Program Brochure \(NSF 09-41\)](#)

Stimulating Research Related to the Science of Broadening Participation

The Directorate for Social, Behavioral, and Economic Sciences and the Directorate for Education and Human Resources have issued joint Dear Colleague Letters to stimulate research related to the science of broadening participation.

http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf14038

The Science of Broadening Participation (SBP) employs the theories, methods, and analytic techniques of the social, behavioral, economic and learning sciences to better understand barriers that hinder and factors that enhance our ability to broaden participation in STEM. This includes supporting research that focuses on institutional, organizational, cultural, social, economic or policy-related factors that impact STEM participation and achievement rates. The results of these efforts inform approaches to increase the access and involvement of under-represented groups in STEM, and provide the scientific evidence that STEM educators, STEM employers, and policy-makers need to make informed decisions and to design effective programs and interventions.

Examples of potential questions related to the SBP include (but are not limited to):

- What are the underlying psychological and social issues affecting different participation and graduation rates in STEM?
- Under what conditions do behavioral, economic, and socio-legal factors influence recruitment and retention in STEM?
- What aspects of preK-12, informal, and higher education learning environments and workplace culture moderate the factors impacting underrepresented minorities, women, and/or persons with disabilities?
- What behavioral or economic processes result in success in STEM?
- What aspects of learning environments and workplace culture moderate the factors impacting STEM participation?
- What are the impacts of a diverse STEM workforce on scientific productivity, innovation, and the economy?

Illustrative Example of SBP Research: *An Interdisciplinary Approach for Increasing Female Involvement and Achievement in STEM* (1327561, PI: Jeni Burnette). Past research suggests that one reason for pervasive gender gaps in computer science is that women often find themselves threatened by the potential to confirm negative stereotypes associated with their gender, termed "identity threat." Drawing on theory that distinguishes between a growth mindset (believing that human attributes can be cultivated) and a fixed mindset (believing human attributes cannot be changed), this research tests a process model designed to overcome the potentially deleterious effects of identity threat, and thus increase the sense of belonging and performance of females in computer science. This research is grounded in the well-supported idea that individuals with growth, relative to fixed, mindsets tend to remain confident, persevere, and perform better.

Broadening Participation Research Track in the EHR/Division of Human Resource Development (HRD)

Text is tailored to each program: LSAMP, TCUP, CREST, and HBCU-UP

Example: HBCU-UP

BROADENING PARTICIPATION RESEARCH IN STEM EDUCATION PROJECTS: Projects of up to three years to conduct a research investigation.

The Broadening Participation Research in STEM Education track exists across programs in the Division of Human Resource Development and may be found in the following solicitations: Alliances for Graduate Education and the Professoriate (AGEP); Centers of Research Excellence in Science and Technology (CREST); Historically Black Colleges and Universities Undergraduate Program (HBCU-UP); Louis Stokes Alliances for Minority Participation (LSAMP); and Tribal Colleges and Universities Program (TCUP). Priorities and restrictions on study populations and awardee institutions may apply depending on the HRD program to which the proposal is submitted.

HBCU-UP Broadening Participation Research (BPR) in STEM Education proposals should be designed to create and study new models and innovations in STEM teaching and learning; enhance the understanding of the underlying issues affecting the differential participation and success rates of students from underrepresented groups; add to the research knowledge base; and inform STEM education practices and interventions. Broadening Participation Research proposals should describe evidence-based research studies that contribute to understanding the participation of and successful outcomes for underrepresented groups in STEM. Proposals should consider new evidence-based strategies and practices and institutional structure models for broadening participation in STEM and increasing the capacity of scholars in minority-serving institutions to conduct this type of research.

Proposed research may investigate behavioral, cognitive, affective, learning and social differences as well as organizational, institutional or systemic processes that may impact participation and success in STEM education. Successful proposals will be grounded in appropriate theory and incorporate recent innovations and advances in research methodologies, conceptual frameworks, and/or data gathering and analytic techniques. Proposals should reflect relevant advances in quantitative, qualitative, and mixed-methods research and evaluation methodologies and provide a compelling argument about how the methodologies proposed are appropriately matched with the strategic research questions of the project. Additionally, proposals should demonstrate how the methods chosen will result in rigorous, cumulative, reproducible, and usable findings to merit peer-review and publication.

Broadening Participation Research proposals must include PIs with demonstrable expertise in education research and/or social science research methods and knowledge about STEM programs at HBCUs. Proposers are encouraged to establish collaborations to strengthen the research project and to describe in the proposal the nature of the collaboration and the anticipated benefits. As appropriate, proposals should describe mechanisms to effectively and efficiently transfer findings into educational practice for use by other researchers and policymakers.

The CISE Investment in Broadening Participation is Making a Difference

CISE funds 8 National Alliances that provide BP resources, develop, test and implement best practices, convene communities of researchers and practitioners, and call the CISE community to action. Examples:

- NCWIT (the National Center for Women and Information Technology) NCWIT is a clearing house, resource center, spokes group, and a convener for the CS community. It houses an Academic Alliance (university departments), K-12 Alliance (teachers and faculty interested in CS K-12 education), Social Science Network (social scientists interested in research and evaluation on broadening participation in computing) , and Entrepreneurial Alliances, and an Industry Alliance.



Selected Outcomes

- 102,447 hard copy resources were distributed, more than 10,000 resource downloads, and two social media campaign conducted. 83% of members shared ideas from at least one resource.
 - The Academic Alliance (AA) grew by 27% in to reach each 22% of US BS population (33,985 undergraduates). 62% of AA members report an increased percentage of women.
 - Those NCWIT Academic Alliance member who are also members of the Computing Research Association (CRA), have outperformed all CRA members in percentage of women students since 2007.
 - While NCWIT Academic Alliance member departments comprise about 1/3 of CRA members, they graduated about 1/2 of the degrees awarded to women by all CRA member institutions.
 - Aspirations in Computing (a program recognizing : 1,088 unique award recipients and 1,600 adult volunteers. The number of affiliate locations increased by 74% (over) 2011.
 - By 2013, the Pace Setter program (teams of university and industry) was responsible for adding 431 net new undergraduate women and 1,254 new mid-career women added to the pipeline.
- The Computer Science Equity Alliance (CSEA)

CSEA is collaboration between UCLA and the LA Unified School District (LAUSD) to introduce a new, introductory Computer Science (CS) course, called Exploring Computer Science (ECS) into high schools. The course and its associated professional development focuses on equity and inclusiveness.

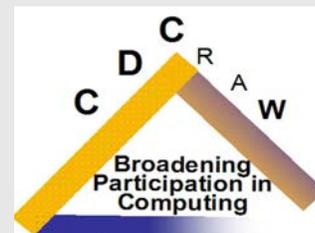


Selected Outcomes

- Prior to this Alliance, LAUSD had no high school-level college prep CS courses; now 8,729 students have taken ECS.
- Of the students taking the course, 80% were African American or Latino and 40% were female.
- ECS has also being introduced in San Jose, Oakland, Chicago, DC, Utah, Portland, Wisconsin, MA, and NYC (among others) . It is being scaled by a public/private partnership with Code.org, that has contracts with 30+ schools districts starting this summer.

- CDC/CRA-W (an Alliance between the Coalition to Diversify Computing and the Computing Research Association's Subcommittee on the Status of Women)

This Alliance focuses on mentoring for women from the undergraduate through the early career stages with the aim of building research careers. It's signature programs provide undergraduate research experiences for women (the CREU and DREU programs).



Selected Outcomes

- Of CS grads in 2011, 39% of those who had participated in CRA-W/CDC undergrad research experiences were enrolled in graduate programs for fall 2011, compared to 22% of students with other research experiences, and 19% of students with no research experiences.
- Of those students who were enrolled in graduate school for fall 2011, 81% of the CRA-W/CDC students were in Ph.D. programs, compared to 41% of the students with other research experiences, and 18% of the students with no research experiences.

- AccessComputing

This Alliance for AccessComputing engages individuals with disabilities as well as those who support, serve, guide, educate, and employ them in transformational efforts to make the computing disciplines more welcoming and accessible to individuals with disabilities, including post-9-11 veterans.



Selected Outcomes

- Of high school students who participated in AccessComputing programs and have now graduated, 100% went on to enroll in college, compared to the national average of 45% for special education students.
- Nationally only 29% of special education students leave their postsecondary institutions with degrees, but in a sample of 229 AccessComputing students, there have been 13 certificates, 25 associates degrees, 52 bachelors degrees, 2 masters, and 2 PhDs.

Louis Stokes Alliance for Minority Participation (LSAMP)

Goal: To develop strategies to increase the quality and quantity of minority students who successfully complete baccalaureate programs in STEM and continue on to graduate studies in these fields

Program Evaluation Report: Revitalizing the Nation’s Talent Pool in STEM

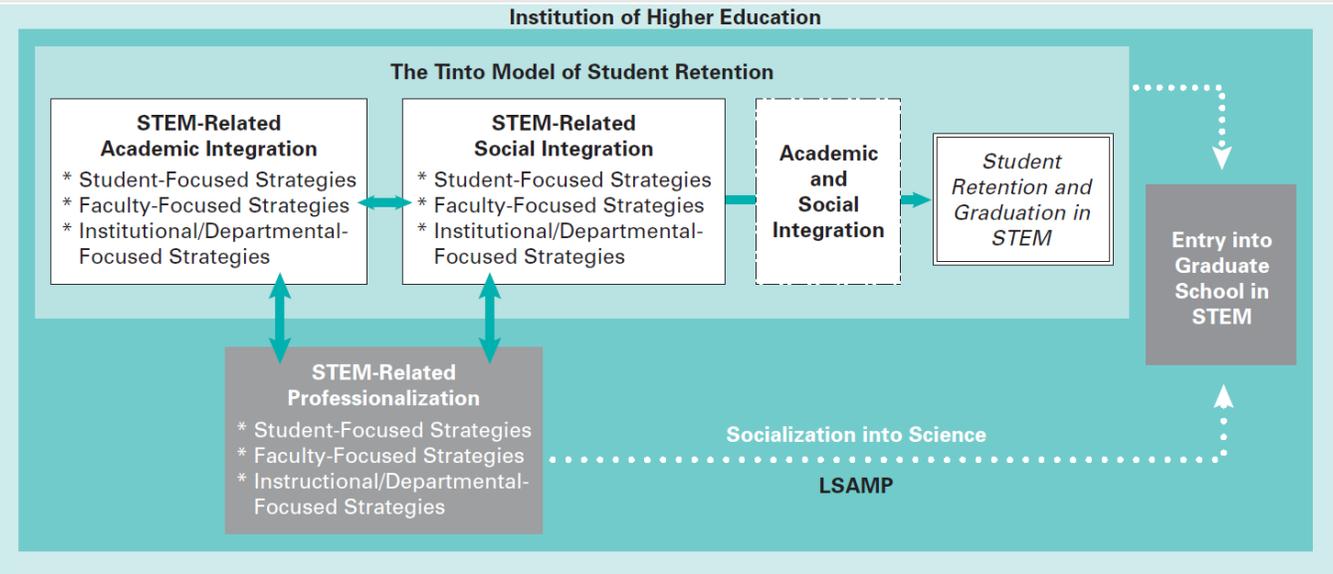
Urban Institute (<http://www.urban.org/url.cfm?ID=311299>)

Key Findings: About 80 percent of LSAMP graduates took further coursework after completing their bachelor’s degrees, compared with about 60 percent of comparison minority and non-minority BA holders. About 45 percent of former LSAMP students completed graduate degrees, while this was true of about 20 percent of national minority and white and Asian bachelor’s degree holders.

Conclusions: LSAMP met its stated goal of increasing the quality and quantity of students who successfully complete LSAMP-supported STEM baccalaureate programs and exceeded its stated goal of increasing the number of students matriculating in programs of graduate study in STEM. Programs like LSAMP, which provide appropriate training and support, holds great promise for revitalizing the STEM workforce in the United States.

Lesson Learned/Best Practices: LSAMP’s strategies and approaches constituted a discrete program model, ground in research and theory, that can be replicated. The two streams of research that merged to form the LSAMP model academic integration research and the socialization into science research.

LSAMP Model



Strategies and Approaches: Elements of the LSAMP Model			
Focus/Activity	STEM Academic Integration	STEM Social Integration	STEM Professionalization
Student			
Summer Bridge	√	√	
Scholarship/Stipend	√		
Peer Study Group	√	√	
Skills-Building Seminar	√	√	
Learning Centers	√	√	
Academic Advising	√		
Summer Academic Enrichment	√		
Tutoring	√		
Research Experience	√	√	√
Mentorships	√	√	√
Conferences	√		√
Internships	√	√	√
Career Awareness			√
GRE Test Preparation	√		√
Graduate School Admissions Support			√
Graduate Summer Bridge	√	√	√
Faculty			
Workshop on Teaching	√		
Diversity Sensitivity Training	√	√	
Faculty Research Program	√		
Institutional/Departmental			
New Course Development	√		
Curriculum Material Sharing	√		
Distance Learning Courses	√		
Changes in Institutional/ Departmental Policies and Practices	√	√	√

NSF Activity: Innovation through Institutional Integration (I³)

<http://nsf-i3.org/>

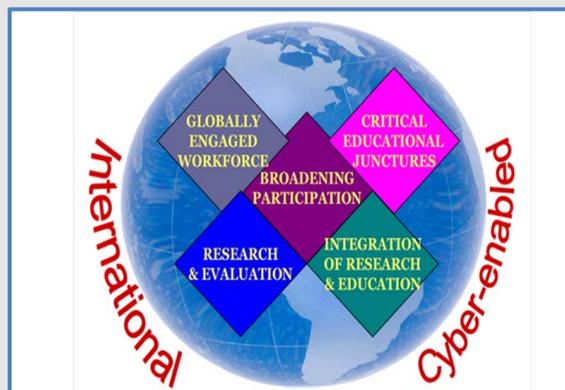
Goals: To increase synergy and collaboration across NSF-funded projects and within/between institutions, towards an educational environment where artificial boundaries are significantly reduced and the student experience is more fully integrated; to expand and deepen the impact of NSF-funded projects and enhance their sustainability

Portfolio Analysis and Progress Monitoring via Annual Reports:

Primary and Secondary Themes of Proposals

Theme	Primary	Secondary
Broadening Participation	41%	29%
Critical Junctures	25%	24%
Global Engagement	1%	10%
Integration of Research and Education	27%	25%
Research Only	6%	12%

Examples of Integration, I³ Style: Georgia Institute of Technology partnered with several colleges and universities to bring together a range of resources to help undergraduates and graduate students effectively pursue teaching careers; Louisiana State University integrated 50 on-going education/mentoring/research grants which were mostly funded by NSF, supporting 50 PhD students, 300 undergraduate students, hundreds of high school teachers, and thousands of K-12 students; University of Washington linked NSF-funded centers to improve the experiences of underrepresented undergraduate minorities, women, and students with disabilities in the College of Engineering; University of Florida created more international experiences for undergraduate and graduate students through collaboration with eminent scientists in locations such as Ghana, France, Brazil, and Argentina; Fort Belknap College brought together all the college's environmental research and education projects under a common administrative umbrella to provide students with an engaging and relevant STEM experience that fully integrated classroom instruction and environmental research opportunities, while grounding student learning in the culture and traditions of the Aaniiin and Nakoda nations.



Evidence of the Value-added/efficiency of an Integrative Approach

New York City College of Technology of the City University of New York (0930242) leveraged its NSF resources (STEP, REU, S-STEM, ADVANCE) to broaden participation by enabling students, the majority of whom are underrepresented in STEM programs of study, to learn STEM applications in laboratories that have been transformed to reflect the collaborative interdisciplinary approaches of advanced science and industry labs today. They built solid partnerships with industry in the NY metro area, especially with the Brooklyn Navy Yard Development Corporation.

Kapiolani Community College of the U. of Hawaii (0833482) leveraged its NSF (TCUP, LSAMP subaward, EPSCoR subaward) resources towards a new Associate of Science in Natural Science Degree program. What's especially interesting is that, through the I³ PI meetings and I³ networking, City Tech and Kapiolani recognized the inherent similarities between their two institutions and funded I³ projects, and initiated a collaborative faculty exchange. In February 2013, four Kapiolani faculty members visited City Tech to learn about their approach to place-based learning, industry-based internships, and case-study learning. In April 2013, five faculty members from City Tech visited Kapiolani to learn more about the Kapiolani undergraduate research experience, the ASNS program pathways, and other aspects of the STEM program. In addition, plans were developed for future student exchanges.

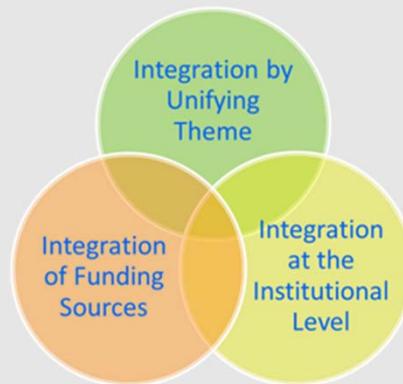
The Purdue University I³ (0964621) for *A Sustainable Energy Concepts Professional development Model for Rural Schools and Its Extension to a Systemic Approach for Integrating STEM Research and Education* is notable for the breadth of funding sources that were integrated for this effort: Noyce, Woodrow Wilson STEM (from ED), EFRC (at DoE), I-STEM (from State of Indiana). In other words, Purdue leveraged resources, not only from NSF, but from other federal and state awards.

Vanderbilt University, with Fisk University and Delaware State University (0930018) integrated its NSF and institutional resources to expand the successful Masters-to-Ph.D. Bridge Program between Vanderbilt and Fisk to a new partner institution, Delaware State University. In 2010-2011, the Vanderbilt/Fisk program became the top producer in the nation of African-American PhDs in physics and astronomy. The partnership leveraged significant institutional support already in place to lay foundations for truly understanding how to best design the model to ensure successful portability into new disciplinary and institutional contexts.

The University of Maryland Baltimore County (1038170) has one of the few research studies funded by I³, *Evaluation, Innovation and Institutionalization of Initiatives to Enhance STEM Student Success*. The project is building on the institution's extensive track record of success in its scholarship programs (e.g., Louis Stokes Alliance for Minority Participation (LSAMP) Phase III, has demonstrated success in increasing the number of underrepresented students who complete STEM degrees; the Scholarships for Science, Technology, Engineering and Mathematics (S-STEM) Program and the Robert Noyce Scholarship Program (including a collaboration with the Math/Science Partnerships program) have demonstrated success increasing STEM majors, generally, and particularly those who will become teachers). The project has carefully designed experiments to evaluate several intervention techniques to determine which have the greatest impact at the lowest cost for expanding participation and increasing

Continued

retention/graduation rates. The integration of these cost-effective techniques across extant programs will reduce per-student costs in retention programs, as well as increase and diversify STEM graduates. The I³ support is promoting a change in the culture as the partnership among senior administrators, department chairs, and project PIs is catalyzing synergistic relationships for current and future scholarship projects to leverage research to focus on both student success and cost-effectiveness strategies.



Key Messages/Lessons Learned:

- When institutions optimize the benefits to be derived from the creative integration of intellectual perspectives or related domains of work, they create important opportunities for making progress on some of the most important scientific, technological, and educational challenges of our time.
- I³ attended to integration at three levels:
 - Thematic integration
 - Integration at the institutional level
 - Integration of funding sources

FY 2015 NSF Budget Request to Congress

**National Science Foundation
Programs to Broaden Participation
FY 2015 Request to Congress**

(Dollars in Millions)

Group/Program	Funding Amount Captured	FY	FY	FY	Change Over	
		2013 Actual	2014 Estimate	2015 Request	FY 2014 Estimate Amount	Percent
Focused Programs		\$161.05	\$168.50	\$167.50	-\$1.00	0.6%
ADVANCE	100%	15.25	16.46	14.90	-1.56	-9.5%
Alliances for Graduate Education & the Professoriate (AGEP)	100%	7.21	7.84	7.84	-	-
AGEP Graduate Research Supplements	100%	2.19	2.00	0.15	-1.85	-92.5%
Biological Sciences Minority Postdoctoral Fellowships	100%	2.50	2.50	2.50	-	-
Broadening Participation in Engineering (BPE)	100%	4.91	6.00	6.00	-	-
Career-Life Balance (CLB)	100%	3.99	1.30	1.00	-0.30	-23.1%
Centers of Research Excellence in Science & Technology (CREST)	100%	22.95	22.98	22.98	-	-
Engineering Graduate Research Diversity Supplements (GRDS)	100%	0.19	-	-	-	N/A
Excellence Awards in Science & Engineering (EASE) ¹	100%	4.70	5.82	5.82	-	-
Geosciences Postdoctoral Fellowships	100%	3.40	3.82	3.82	-	-
Historically Black Colleges & Universities Undergraduate Program (HBCU-UP)	100%	30.30	31.94	31.94	-	-
Louis Stokes Alliances for Minority Participation (LSAMP)	100%	42.03	45.62	45.62	-	-
Partnerships for Research & Education in Materials (PREM)	100%	5.55	3.72	6.43	2.71	72.8%
Partnerships in Astronomy & Astrophysics Research Education (PAARE)	100%	0.91	1.00	1.00	-	-
Pre-Engineering Education Collaboratives (PEEC)	100%	1.00	1.00	1.00	-	-
SBE Postdoctoral Research Fellowships - Broadening Participation	100%	0.59	1.50	1.50	-	-
Tribal Colleges & Universities Program (TCUP)	100%	12.39	13.50	13.50	-	-
SBE Science of Broadening Participation	100%	1.00	1.50	13.50	-	-
Emphasis Programs		\$446.08	\$469.57	\$495.84	\$26.27	5.6%
Advancing Informal STEM Learning (AISL)	58%	27.85	31.90	31.90	-	-
Centers for Ocean Science Education Excellence (COSEE) ²	68%	0.67	-	-	-	N/A
Discovery Research K-12 (DR-K12)	72%	69.62	66.62	73.82	7.20	10.8%
Graduate Research Fellowship (GRF)	59%	143.34	177.00	196.73	19.73	11.1%
Innovative Technology Experiences for Teachers & Students (ITEST) ³	70%	22.06	17.50	17.50	-	-
International Research Experiences for Students (IRES)	73%	2.26	1.64	1.64	-	-
Noyce Scholarships	59%	30.15	35.93	35.93	-	-
NSF Scholarships in STEM (S-STEM) ³	57%	47.87	42.75	42.75	-	-
Ocean Sciences Research Initiation Grants (OCE-RIG)	100%	0.60	0.60	-	-0.60	-100.0%
Research Experiences for Undergraduates (REU) - Sites and Supplements	61%	45.21	45.89	45.83	-0.06	-0.1%
STEM, including Computing Partners hips (STEM-C Partnerships) ⁴	72%	46.61	49.74	49.74	-	-
<i>Computing Education for the 21st Century (CE21)</i>	68%	8.30	-	-	-	N/A
<i>Math Science Partnership (MSP)</i>	73%	38.31	-	-	-	N/A
STEM Talent Expansion Program (STEP)	58%	9.84	-	-	-	N/A
Total, Focused and Emphasis Programs		\$607.12	\$638.07	\$663.34	\$25.27	4.0%

FY 2015 NSF Budget Request to Congress

Group/Program	Funding Amount Captured	FY 2013	FY 2014	FY 2015	Change Over FY 2014 Estimate	
		Actual	Estimate	Request	Amount	Percent
Total, Focused and Emphasis Programs		\$607.12	\$638.07	\$663.34	\$25.27	4.0%
Geographic Diversity Program		\$147.60	\$158.19	\$159.69	\$1.50	0.9%
EPSCoR	100%	147.60	158.19	159.19	1.50	0.9%
Total, NSF		\$754.73	\$796.26	\$823.03	\$26.77	3.4%

Totals may not add due to rounding.

¹ The Excellence Awards in Science and Engineering (EASE) program is comprised of both Presidential Awards for Excellence in Science, Math and Engineering Mentoring (PAESMEM) and Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST).

² The COSEE program terminated in FY 2014.

³ NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) and Innovative Technology Experiences for Students and Teachers (IT EST) are H1B Visa funded programs.

⁴ In FY 2014, Computing Education for the 21st Century (CE21) and Math Science Partnership (MSP) merged into Science, Technology, Engineering, and Mathematics, including Computing Partnerships (STEM-C Partnerships).

Focused Programs have broadening participation as an explicit goal of the program and are included at 100 percent of their funding.

Emphasis Programs have broadening participation as one of several emphases but broadening participation is not an explicit goal of the program. These programs are included at a percentage of their funding level. The percentage used equals the 3-year average percentage of the programs' award portfolio that meets one the following criteria:

- At least 50 percent of the principle investigators are from an underrepresented group;
- The award was to a Minority Serving Institution (MSI); or
- At least 50 percent of the students or postdocs supported by the grant reported themselves as members of an underrepresented group on project reports.

Geographic Diversity Program, EPSCoR, has geographic diversity as an explicit goal of the program and is included at 100 percent of its funding.



Broadening Participation Portfolio

NSF has taken a variety of approaches to broaden participation across its many programs. While broadening participation is included in the NSF review criteria, some program announcements and solicitations go beyond the standard criteria. They range from encouraging language to specific requirements. Investments range from capacity building, research centers, partnerships, and alliances to the use of co-funding or supplements to existing awards in the core research programs.

Broadening Participation Focused Programs

1. ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers ([NSF 14-573](#))
2. Alliances for Graduate Education and the Professoriate (AGEP) ([NSF 14-505](#))
3. Broadening Participation in Engineering (BPE) ([NSF PD 14-7680](#))
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504870
4. Centers of Research Excellence in Science & Technology (CREST) & HBCU Research Infrastructure for Science & Engineering (RISE) ([NSF 14-565](#))
5. EPSCoR Research Infrastructure Improvement Program Track 3: Building Diverse Communities (RII Track-3) ([NSF 13-553](#))
6. EPSCoR Research Infrastructure Improvement Program Research: Workshop Opportunities (EPS-WO) ([NSF 12-588](#))
7. General & Age-Related Disabilities Engineering (GARDE) ([NSF PD 14-342](#))
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501021
8. Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) ([NSF 14-513](#))
9. Louis Stokes Alliances for Minority Participation (LSAMP) ([NSF 12-564](#))
10. NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) ([NSF 12-529](#))
11. Ocean Sciences Postdoctoral Research Fellowships (OCE-PRF) Broadening Participation ([NSF 13-603](#))
12. Ocean Sciences Research Initiation Grants (OCE-RIG) Broadening Participation ([NSF 13-606](#))
13. Partnerships for Research and Education in Materials (PREM) ([NSF 11-562](#))
14. Partnerships in Astronomy & Astrophysics Research and Education (PAARE) ([NSF 13-566](#))
15. Postdoctoral Research Fellowships in Biology (PRFB) ([NSF 12-497](#))
16. Research on Education and Learning (REAL) ([NSF 13-604](#))
17. SBE Postdoctoral Research Fellowships (SPRF) ([NSF 12-591](#))
18. Tribal Colleges and Universities Program (TCUP) ([NSF 14-572](#))

Broadening Participation Emphasis Programs

1. Advancing Informal STEM Learning (AISL) ([NSF 14-555](#))
2. **American Competitiveness in Chemistry-Fellowship** (ACC-F) ([NSF 10-535](#))
3. Centers for Chemical Innovation (CCI) ([NSF 13-590](#))
4. * Discovery Research K-12 (DR K-12) ([NSF 13-601](#))
5. Emerging Frontiers in Research and Innovation 2014 (EFRI-2014): Two-Dimensional Atomic-Layer Research and Engineering (2-DARE) ([NSF 13-583](#))
6. Gen-3 Engineering Research Centers (ERC): Partnerships in Transformational Research, Education, and Technology ([NSF 13-560](#))
7. Graduate Research Fellowship Program (GRFP) ([NSF 13-584](#))
8. Innovative Technology Experiences for Students and Teachers (ITEST) ([NSF 14-512](#))
9. **Integrative Graduate Education and Research Traineeship Program (IGERT)** ([NSF 11-533](#))
10. International Research Experiences for Students (IRES) ([NSF 12-551](#))
11. Major Research Instrumentation Program (MRI) ([NSF 13-517](#))
12. Materials Research Science and Engineering Centers (MRSEC) ([NSF 13-556](#))
13. * **Mentoring Through Critical Transition Points in the Mathematical Sciences (MCTP)** ([NSF 11-542](#))
14. NSF Earth Sciences Postdoctoral Fellowships (EAR-PF) ([NSF 13-548](#))
15. Postdoctoral Fellowships in Polar Regions Research ([NSF 09-612](#))
16. Research Experiences for Undergraduates (REU) ([NSF 13-542](#))
17. Research Training Groups in the Mathematical Sciences (RTG) ([NSF 11-540](#))
18. Science and Technology Centers: Integrative Partnerships ([NSF 11-522](#))
19. Science of Learning Centers (SLC) ([NSF PD 07-7278](#))
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5567
20. STEM - Computing Education for the 21st Century (CE21) ([NSF 14-523](#))
21. STEM-C Partnerships: MSP ([NSF 14-522](#))

Programs in **RED** color still have active awards but no longer accepting proposals.

* Programs are not listed on BP Portfolio website; they are included on NSF BP Budget Table 10.



Broadening Participation Portfolio *

Broadening Participation - Dear Colleague Letters

1. Announcement of Effort to Broaden the Participation of Students in Two-Year Hispanic Serving Institutions in Science, Technology, Engineering, and Mathematics (STEM) ([NSF 14-065](#))
2. Announcement of Efforts to Increase Hispanic Participation in STEM Fields ([NSF 12-081](#))
3. EFRI Research Experience and Mentoring (REM) ([NSF 13-032](#))
4. Engineering Research Experiences for Veterans (EREV) ([NSF 12-074](#))
5. Engineering Research Experiences for Veterans ([NSF 12-074](#))
6. FY2013 Career-Life Balance (CLB) - Graduate Research Fellowship Program (GRFP) Supplemental Funding Requests ([NSF 13-099](#)) **
7. FY2013 Career-Life Balance (CLB) - Faculty Early Development Program (CAREER) Supplemental Funding Requests ([NSF 13-075](#)) **
8. FY 2013 Career-Life Balance (CLB) Supplemental Funding Opportunities in support of Postdoctoral Investigators funded by NSF awards ([NSF 13-109](#))
9. EFRI Research Experience and Mentoring (REM) ([NSF 13-032](#))
10. MPS Alliances for Graduate Education and the Professoriate - Graduate Research Supplements (MPS-AGEP-GRS) ([NSF 13-071](#))
11. Prepare, Engage, and Motivate a Diverse STEM Workforce ([NSF 12-034](#))
12. Research Assistantships for High School Students (RAHSS): Supplemental Funding to Current SBIR/STTR Phase II Awards to Broaden Participation in Science and Engineering ([NSF 14-073](#))
13. Research Assistantships for High School Students (RAHSS): Funding to Broaden Participation in the Biological Sciences ([NSF 12-078](#))
14. Research Assistantships for High School Students (RAHSS) - SBIR/STTR Phase II Supplements ([NSF 06-003](#))
15. Research Experience for Teachers (RET): Funding Opportunity in the Biological Sciences ([NSF 12-075](#))
16. Research Experiences for Veterans/Teachers (REV/T) ([NSF 12-073](#))
17. Research in Disabilities Education (RDE) and Research on Gender in Science and Engineering (GSE) in the New Research on Education and Learning (REAL) Solicitation, NSF 13-604 ([NSF 14-012](#))
18. SBIR/STTR Supplemental Funding for Community College Research Teams ([NSF 08-029](#))
19. Stimulating Research on Effective Strategies in Undergraduate STEM Education at Two-Year Hispanic Serving Institutions ([NSF 14-064](#))
20. Stimulating Research Related to the Science of Broadening Participation ([NSF 14-038](#))
21. Supplemental Opportunity for Small Business Innovation Research and Small Business Innovation Research/Small Business Technology Transfer for CREST/HBCU-RISE Collaborations ([NSF 12-069](#))

For further information concerning NSF's
Broadening Participation programs, please contact:

Dr. Wanda E. Ward
National Science Foundation
Tel: 703-292-8040
E-mail: broadpart@nsf.gov

http://www.nsf.gov/od/broadeningparticipation/bp_portfolio_dynamic.jsp



* On Page 1, Programs are not listed on NSF BP Portfolio website, they are included on FY 2014 NSF BP Budget Table 10.

** Please refer to CLB webpage, <http://www.nsf.gov/career-life-balance/> for more details.

Conferences that Target Diversity in Science and Engineering**Black Engineer of the Year****February 6-8, 2014**

Location: Washington, DC

For more information, please visit

http://intouch.ccgmag.com/BlankCustom.asp?page=beya_stem_conference**Richard Tapia Conference on Computing****February 5-8, 2014**

Location: Seattle, WA

For more information, please visit <http://tapiaconference.org/supporters/>**MAES Leadership Academy****February 6-8, 2014**

Location: Seattle, WA

For more information, please visit <http://mymaes.org/program-item/nlc/>**AAAS Annual Meeting****Feb 13-17, 2014**

Location: Chicago, IL

For more information, please visit <http://meetings.aaas.org/program/>**National Society of Black Engineers Annual Convention****March 26- 30, 2014**

Location: Nashville, TN

For more information, please visit <http://www.nsbe.org/Convention/2014/NSBE40.aspx>**NCWIT Summit on Women and IT****May 19-21, 2014**

Location: Newport Beach CA

For more information, please visit

<https://www.ncwit.org/summit/2014-ncwit-summit-women-and-it>**Women in Engineering Program Advocates Network Change Leader Forum****June 9-11, 2014**

Location: Minneapolis, MN

For more information, please visit <http://wepan.org/displaycommon.cfm?an=1&subarticlenbr=530>**ASEE Annual Conference & Exposition****June 15-18, 2014**

Location: Indianapolis, IN

For more information, please visit <http://www.asee.org/conferences-and-events/conferences/annual-conference/2014>

Conferences that Target Diversity in Science and Engineering**GEM Consortium Annual Meeting****August 13-15, 2014**

Location: San Diego

For more information, please visit

<http://egem.gemfellowship.org/events/ViewEvent.aspx?contextID=10104>**Great Minds in STEM, HENNAC Annual Conference****October 2-4, 2014**

Location: New Orleans, LA

For more information, please visit <http://www.greatmindsinstem.org/conference/conference-home>**National Action Council for Minorities in Engineering (NACME) Anniversary Awards Dinner and Celebration****October 15, 2014**

Location: New York, NY

For more information, please visit <http://www.nacme.org/events/upcoming-nacme-events>**SACNAS****October 15-19, 2014**

Location: Los Angeles, CA

For more information, please visit <http://sacnas.org/events/national-conf>**MAES Symposium****October 14-18, 2014**

Location: San Diego, CA

For more information, please visit <http://mymaes.org/programs/events/>**Society of Asian Scientists and Engineers Annual Conference and Career Fair****October 16-18, 2014**

Location: Philadelphia, PA

For more information, please visit <http://saseconnect.org/sase-national-conference-career-fair-2014>**Society of Women Engineers Annual Conference and ICWES (International Network of Women Engineers and Scientists) 16****October 22-25, 2014**

Location: Los Angeles, CA

For more information, please visit <http://we14.swe.org/>**Women of Color Annual STEM Conference****October 23-25, 2014**

Location: Detroit, MI

For more information, please visit http://intouch.ccgmag.com/page/woc_conference

Conferences that Target Diversity in Science and Engineering

Out and Equal Workplace Summit

November 3-6, 2014

Location: San Francisco, CA

For more information, please visit <http://outandequal.org/annual-summit>

Society of Hispanic Professional Engineers National Conference

November 5-9, 2014

Location: Detroit, MI

For more information, please visit <http://www.shpe.org/index.php/events>

American Indian Science and Engineering Society National Conference

November 13-15, 2014

Location: Orlando, FL

For more information, please visit <http://www.aises.org/nationalconference/nextvenue>

Out in STEM Annual Meeting

November

Location: Atlanta, GA

For more information, please contact them at info@ostem.org

NOGLSTP OUT to Innovate

November 8-9

Location: Atlanta, GA

For more information, please visit http://www.noglstp.org/?page_id=75

Surmounting the Barriers: Ethnic Diversity in Engineering Education
Summary of a Workshop , http://www.asee.org/Surmounting_the_Barriers.pdf

Five-fold Purpose:

- To identify and illuminate the impediments to diversity
- To understand why previous diversity recommendations had not been implemented or, if implemented, why they had fallen short
- To share success stories about instances where barriers to diversity had been identified and surmounted
- To identify the resources that would enable real solutions to implement steps toward progress
- To locate supporters and allies who could propel change

Six (Historical) Strategic Themes for Achieving Diversity

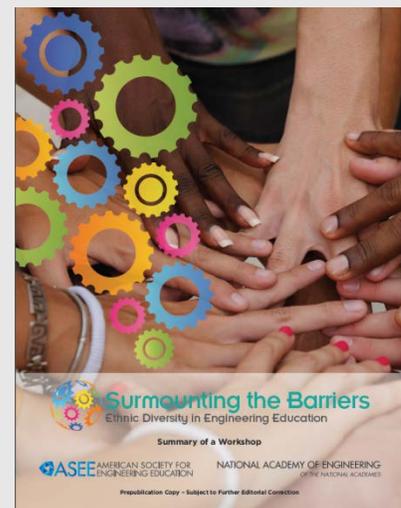
- Inculcating and reinforcing students' academic and professional knowledge
- Pedagogical enhancement of future and current teachers and faculty
- Strengthening organizational receptivity to ethnic diversity
- Enhancing economic enablement of students and student-support organizations
- Enhancing stakeholder communications and action
- Increasing educational research and policy development

Key Underlying Impediments to Implementing Recommended Strategies

- Lack of incentives or inadequate/short-term financial support
- Unsupportive institutional and faculty culture and environment
- Lack of institutional and constituent engagement
- Systemic problems among institutions of higher education
- Curriculum issues
- Problems with evaluation (measures and metrics)

13 Suggestions for Change

- Link greater diversity to the college and university's mission.
- Make a business case for why diversity matters.
- Improve two- to four-year pathways.
- Revise hiring strategies.
- Know your students.
- Make engineering approachable.
- Make an institutional commitment via funding.
- Seek partners in local industry.
- Capitalize on proven successes.
- Deal with problem faculty and seek out and reward willing allies.
- Push for change at the government level.
- Leverage the professional societies and organizations.
- Spread the word (about best practices).



Coming Soon:

https://www.nsf.gov/mps/broadening_participation/index.jsp

MPS Broadening Participation Resources

NSF has a strong commitment to [broadening participation](#). Groups underrepresented in MPS research include women, African Americans, Hispanic Americans, Native Americans, and persons with disabilities.

The links below provide a sampling of information that may help Principal Investigators and others in broadening participation in their activities. This list is not meant to be exhaustive or to imply any special endorsement by MPS (or NSF).

RECRUITMENT	RETENTION and MENTORING
<ul style="list-style-type: none"> • NSB Report: The Science and Engineering Workforce - Realizing America's Potential 03-69 • NSB Report on Broadening Participation 04-41 • Race-Neutral Approaches to Diversity [student recruitment] • Finding Qualified Minorities and Women [faculty recruitment] • Faculty Recruitment Handbook (UMI) [faculty recruitment] • Disabilities Workshop Final Report • Sloan Manual [student recruitment] • American Psychological Association Minority Recruitment, Retention, and Training [faculty recruitment] 	<ul style="list-style-type: none"> • Preparing Women and Minorities for the IT Workforce [retention of students] • MentorNet [mentoring students through untenured faculty] • Optimizing the Learning Environment for Students with Disabilities [including links to laws and other resources, broken down by disability type] • Visual Impairment Links [employee retention, with links to other resources] • American Psychological Association Minority Recruitment, Retention, and Training [faculty recruitment]
RESOURCES	NETWORKS and ORGANIZATIONS
<ul style="list-style-type: none"> • NSF Statistics: Science and Engineering Indicators • Implicit Association Tests • Diversity Myths and Realities • 2007 Diversity Update • Land of Plenty report: Diversity as America's Competitive Edge in Science, Engineering and Technology • NSF-Funded Science Diversity Center • Gender Equity Indicators in the USA • National Institutes of Health (NIH) The Office of Research on Women's Health (ORWH) • NIH Women of Color • National Academies' Committee on Women in Science, Engineering, and Medicine (CWSEM) 	<ul style="list-style-type: none"> • National Federation for the Blind (NFB) Learning Resources [includes link to NSF supported National Center for Blind Youth in Science] • Society for Advancement of Chicanos and Native Americans in Science (SACNAS) • National Organization for the Professional Advancement of Black Chemists & Chemical Engineers (NOBCChE) • National Society of Black Physicists (NSBP) • American Indian Science & Engineering Society (AISES) • National Society of Hispanic Physicists (NSHP) • Women in Engineering Programs and Advocates Network (WEPAN) • Association for Women in Science (AWIS) • American Association of University Women (AAUW)

ACADEMIC INSTITUTIONS

- [National Technical Institute for the Deaf](#)
- [PEPNet \(Postsecondary Education Programs Network\)](#) [addresses needs of individuals with deafness, including those who are deaf with co-occurring disabilities]
- [Department of Education Site](#)
- [Pacific Islander and Asian Institutions](#)
- [Tribal Colleges and Universities](#)
- [Hispanic Serving Institutions](#)
- [Women's Colleges](#)
- [Historically Black Colleges and Universities \(HBCU\)](#)

Math & Physical Sciences



Programmatic Evidence of Results,
Lessons Learned,
Promising / Best Practices
for
Broadening Participation

Rural Systemic Initiative (RSI)

Goal: to ensure that all students in participating rural communities were prepared for 21st century as citizens and workers with a quality education in mathematics and science

Report of the Evaluative Study: *A Legacy of Leadership and Lessons Learned: Results from the Rural Systemic Initiative for Improving Mathematics and Science Education*
http://sites.edvantia.org/products/pdf/rsi_Report_0706.pdf

Key Findings/Conclusions: There was a positive pattern across projects for at least 80 percent of participating districts to implement K-12 science or mathematics curricula aligned with their state’s standards for science and/or mathematics. Each of the RSI experienced success in preparing teachers for new leadership roles that influenced curriculum and instructional practices in mathematics and science; teaching practices also incorporated indigenous knowledge systems and ways of knowing in rural/Native communities. Improving student achievement was a key outcome that included student performance gains on district-level assessments and state-wide assessment systems. A one-size-fit-all reform approach-inconsiderate of realities in communities and schools in rural America-is unlikely to inspire the leadership, local ownership, and persistence necessary to change the status quo. However, the RSI investment in leadership provided a foundation for these communities to further develop their human resources in partnership with all key stakeholders—a critical next step for increasing the quality of life for rural communities while also increasing America’s competitiveness in the world.

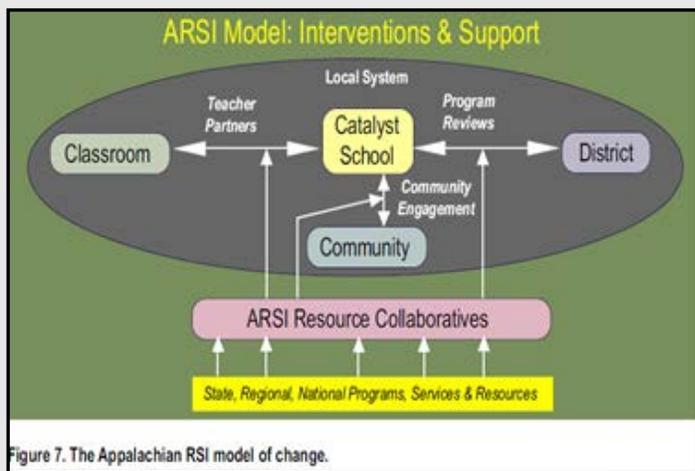


Figure 7. The Appalachian RSI model of change.

The Application RSI Model of Change

Costal RSI program improvement model

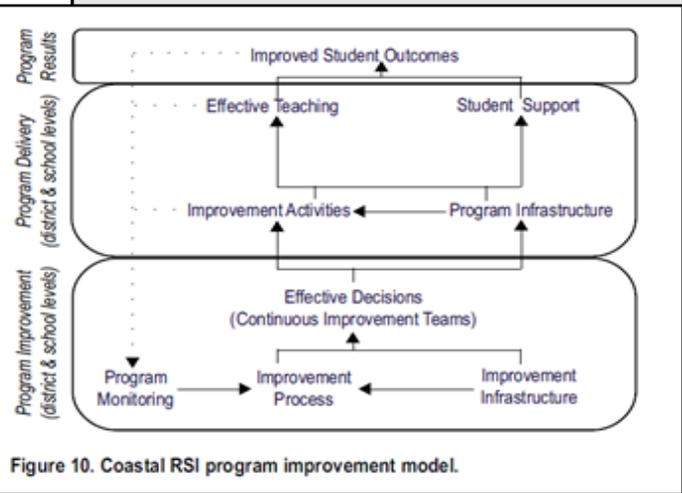
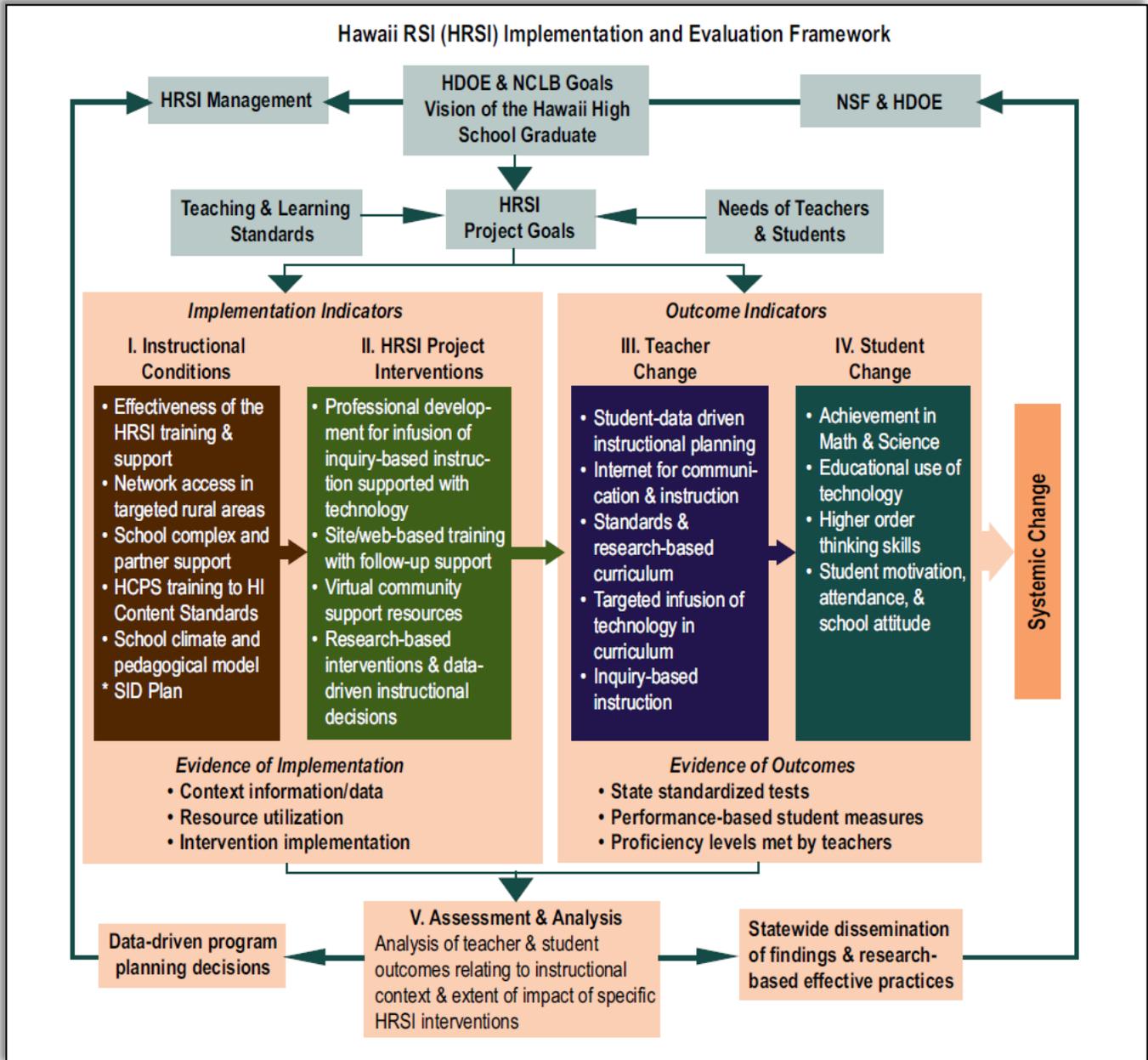


Figure 10. Coastal RSI program improvement model.

Hawaii RSI Logic Model for Project Implementation and Evaluation



Lessons Learned:

1. Adopting a standards-based curriculum created a catalyst for all teachers to examine their teaching practices and was instrumental in ensuring that all professional development opportunities focused intensively on effective teaching all students to achieve the higher levels of content and conceptual understanding that are critical elements of the new curricula.
2. Math and science specialists can help classroom teachers on an individual basis to move from lower to higher levels of implementation (i.e., examining the effect of the curriculum and pedagogy on student learning). Specialists can be the source of the new ideas, encouragement, and materials for teachers. A critical part of teachers' successful implementation of new learning is the on-site support provided by the RSI regional specialists.
3. School and district administrators play a critical role in sustaining the RSI efforts because they control district resource allocations.
4. Parents will come to school improvement family events, even in high-poverty rural areas with a history of low parent participation at other kinds of activities.
5. Partnerships contribute to reducing the isolation of rural districts. Teachers must learn to use the resources in their areas, such as state parts, to provide field experiences for their students. Teachers and administrators need to build relationships with university faculty members and informal science providers that will continue after the NSF RSI funding ends.
6. Without RSI support, administrators must be concerned about the budget for additional instructional materials and high-quality professional development experiences for teachers.
7. Teachers want administrators to demonstrate their support of RSI by scheduling time for teachers to share/plan with each other. In districts where administrators understood the RSI model, teacher partners were encouraged to participate in academies and institutes, time was provided for them to share with other teachers, and funds were allocated to support reform efforts.
8. The RSI created a cohort at the district level that facilitated free-flowing communication up and down the instructional line. Teachers can and will step up to leadership roles, given appropriate and adequate professional development, and the opportunity and encouragement by their school and/or district administrators.
9. Culturally responsive science curriculum has to do with presenting science within the whole of cultural knowledge in a way that embodies that culture—connecting what is known about Western science education to what local people know and value.
10. Partners are absolutely essential to systemic change, but it is important to select partners that add value and provide diverse, needed resources. Leaders of change need to know what potential partners bring to the table and what they expect to gain or achieve through their partnering.

The models and methods used by the RSIs varied but they all found ways to be successful in developing leadership capacity, building support for program improvement within the administrative structure of the school system; and leveraging the success of other systemic initiatives, programs, and materials developed through NSF support.

Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)

Goal: To enhance the quality of undergraduate education and research in STEM at HBCUs as a means to broaden participation in the nation's STEM workforce

Program Evaluation Report: *Capacity Building to Diversify STEM: Realizing Potential among HBCUs*
Urban Institute, 2010

(http: <http://www.urban.org/uploadedpdf/412312-Capacity-Building-to-Diversify-STEM.pdf>)

Key Findings: HBCU-UP graduates outperform the national comparison group in graduate degree completion. Over one-quarter of HBCU-UP alumni, pursued post-baccalaureate coursework in STEM. HBCU-UP graduates are more likely to complete master's degrees and are as likely as the national comparison groups to complete doctoral and professional degrees. HBCU-UP African American graduates experience greater insertion in the STEM workforce than the national African American comparison peers.

Conclusions: HBCU-UP grantees succeeded in building an institutional infrastructure that supports the education of STEM majors. The HBCU-UP program successfully contributed to the education and retention of women, especially minority women, in STEM.

Lessons Learned/Best Practices: Successful HBCU-UP projects shared elements that suggest effective projects (a) design interventions to address well-defined problems; (b) provide a comprehensive array of strategies that span institutional infrastructure improvement, faculty development, and student support services; (c) tailor their strategies and activities to their institutional mission and characteristics; and (d) institutionalize the key components of their projects. The HBCU-UP program yielded an intervention model characterized by a core set of strategies associated with successful student outcome:

CORE Strategies for Capacity Building

Student

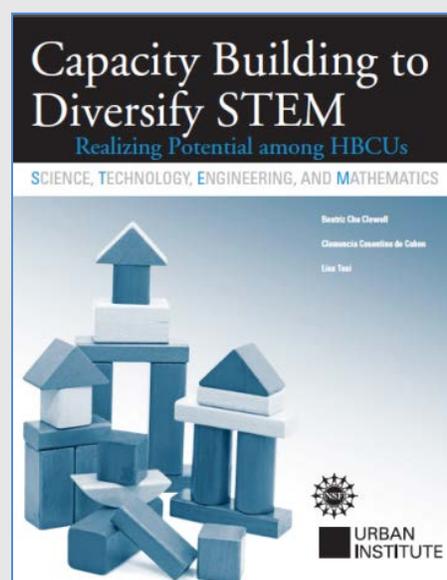
Research opportunities
Academic support
Summer bridge

Faculty

Pedagogy training
Professional development

Institution

Course development/reform
Facilities improvements and resources
Collaborations with NSF programs
Instructional strategies



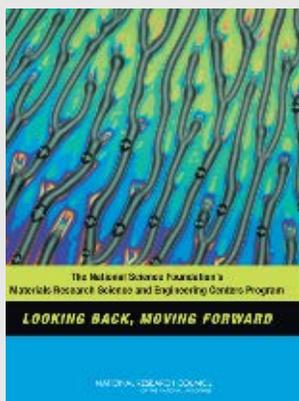
Materials Research Science and Engineering Centers Program (MRSECS)

Goals: to ensure the strength for university-based material research ... broadening participation by increasing the number of women and other underrepresented groups involved in MRSEC activities

Report of Expert Assessment: *Looking Back, Moving Forward*
National Research Council

Key Findings/Conclusions: Outstanding discoveries, leading research groups, and most significant publications worldwide are associated with universities at which there are MRSECS. Since 2001, MRSECS have been required to develop formal “diversity plans” and show results from those plans over the course of the MRSEC grant. Data revealed that MRSECS were having the most success at broadening participation in undergraduate and precollege audiences. The involvement with underrepresented minorities needed improvement at the graduate student and higher levels.

Lessons Learned: Some of the strategies that MRSECS used to broaden participation included partnerships with women’s colleges and minority-serving institutions [through the Partnerships for Research and Education in Material (PREM) program]; interactions with K-12 schools serving underrepresented populations; alliance with professional associations for minority scientists and engineers; and participating in or holding special programs for underrepresented groups.



http://www.nsf.gov/attachments/118193/public/LookingBackMovingForwardNSF_sMRSEC.pdf

Partnerships for Research and Education in Materials (PREM)

The PREM program was established in 2004 to develop materials research and education partnerships between minority-serving institutions (MSIs) and MRSECS.

PREM aims to create cooperative research teams and provide experimental facilities to the partner institutions, thus providing additional research and education opportunities for students and faculty

Model Institutions for Excellence (MIE)

Goal: to support a long-term initiative designed to increase the representation in STEM by 1) targeting a small number of minority-serving institutions poised to make a substantial contribution to increasing the number of minorities who earn STEM baccalaureate degrees and then enroll in STEM graduate programs or enter STEM careers; 2) improving science, engineering and mathematics education and undergraduate research at the selected MS; and 3) enabling successful projects to serve as models for recruitment, education and production of quality trained STEM baccalaureate degree recipients.

Program Assessment Report: *Creating and Maintaining Excellence: The Model Institutions for Excellence Program*; American Institutes for Research, 2005

http://www.air.org/sites/default/files/downloads/report/MIE_Report_final_0.pdf

Findings: With one exception, STEM enrollment tended to increase faster than overall institutional enrollment at each of the six MIE institutions. With one exception because the primary focus was on program enhancements, the number of undergraduate STEM conferred and the proportion of all degrees awarded that were in STEM fields increased considerably in all MIE institutions. STEM degrees tended to increase faster in the MIE institutions than they did in the Historically Black Colleges and Universities, Hispanic-Serving Institutions, and in a group of non-funded MIE applicants.

Lessons Learned: The study of MIE projects suggested a model with seven components that are readily transportable. The model, however, must be aligned to the context of the institution. Moreover, further study is needed to understand the influence of cultural factors that are unique to African Americans, Hispanics and Native Americans that influence their success at MSIs and non-MSIs.

The review of the MIE projects suggested a model with seven components. These components are defined as follows:

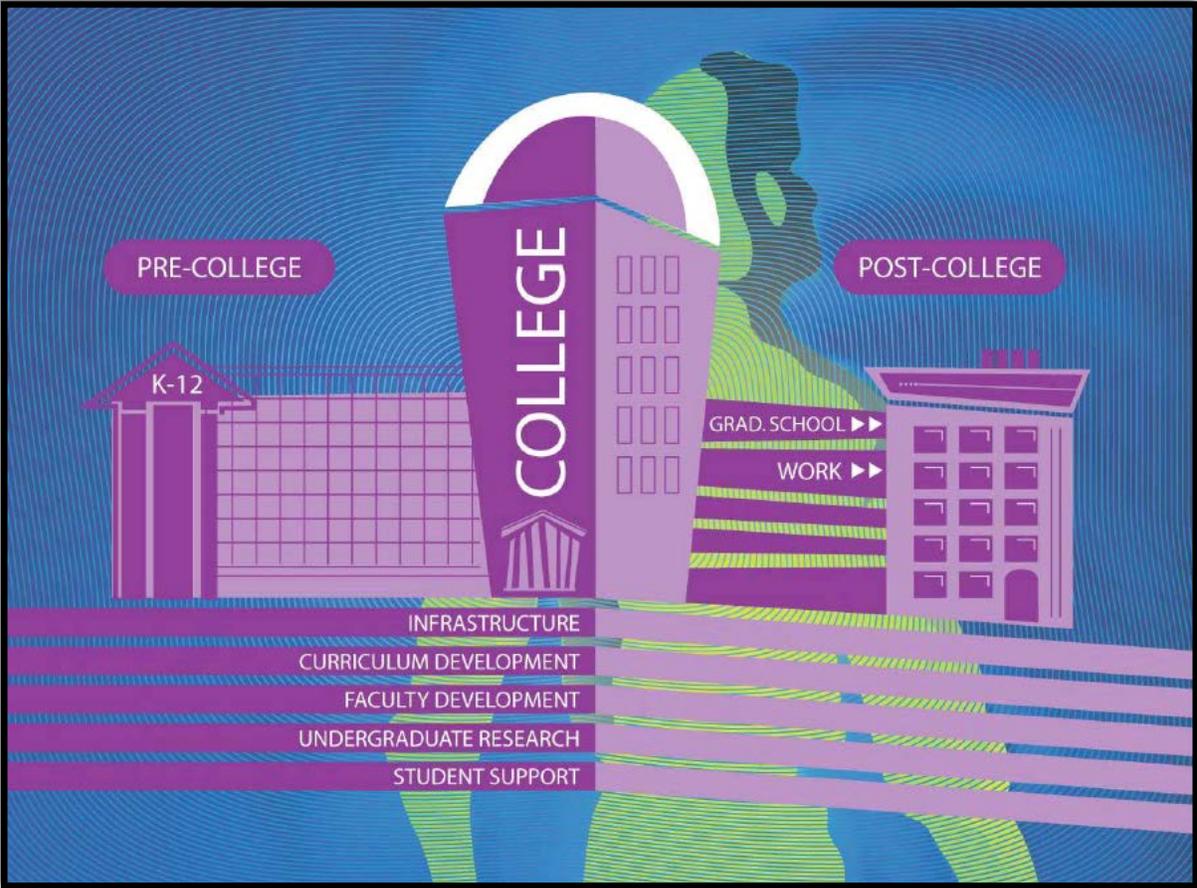
- **Recruitment and Transition Initiatives:** Activities to prepare matriculating students to succeed in college and to introduce students to STEM disciplines and careers. These initiatives include such activities as:
 - o Training elementary, middle, and high-school teachers to improve their content knowledge and teaching ability
 - o Introducing young students to the STEM world through hands-on activities (e.g., science fairs, Geographic Information Systems (GIS) mapping)
 - o Bridging the transition from high school or community college into college or university (e.g., summer orientation programs)
- **Student Support:** Social, financial, and academic assistance to students. This includes such activities as:
 - o Supporting peer and/or teacher/student mentoring programs
 - o Tutoring
 - o Providing and/or advising on opportunities for financial aid
 - o Starting each course at the point at which most students have sufficient background to understand basic concepts
 - o Scheduling “cohort” programs in which a small group of students may take some or all core subjects together

- o Especially at commuter campuses, establishing a place where groups of students can meet and study with one another
- o Scholarships, grants and funding for research and presentations of research projects
- **Undergraduate Research:** Enabling students to become directly involved in on-going research. Associated activities might include:
 - o Encouraging faculty to include funding for undergraduate researchers in their research proposals
 - o Student internships
 - o Having students write and present research findings (both on campus and at conferences)
 - o Establishing liaisons with businesses and other universities to expand the opportunities for graduate research
 - o Maintaining a supportive environment in which a student may experiment (and fail) without negative consequences

Faculty Development: Recruitment, retention and professional development of faculty. This includes:

- o Funding for research, conferences, and professional development
- o Mentoring
- o Setting appropriately balanced (and rewarded) teaching and research agendas
- o Professional development on interactive classroom methods, mentoring, and integrating student researchers into faculty research activities
- **Curriculum Development:** Alignment of curriculum with accepted content standards and the development of courses that are relevant to the marketplace, the community and the student population. These activities include:
 - o Providing developmental courses to bring entering students up to a required standard
 - o Integrating curriculum to help students build connections
 - o Introducing relevant history and culture into all courses
 - o Ensuring culturally responsive pedagogy
 - o Developing new courses and majors
- **Physical Infrastructure:** Upgrading and maintaining facilities and equipment. This includes:
 - o Renovating classrooms and laboratories
 - o Purchasing, upgrading and maintaining state-of-the-art equipment
 - o Designing spaces for students to meet and study
- **Graduate and Science Career Initiatives:** Activities designed to facilitate admission and retention in STEM graduate programs and/or careers. Related activities include:
 - o Providing graduate school admissions test preparation courses
 - o Educating students on academic and professional supply and demand trends in STEM fields
 - o Establishing a bridging program for students transitioning out of college
 - o Providing job placement services

The MIE Model



NSF Leaders and Broadening Participation Point of Contacts: 2014

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NSF Leaders and Broadening Participation Point of Contacts: 2014

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NSF Broadening Participation Working Group Charge

The National Science Foundation is recognized as a leader in broadening participation in the science and engineering research and education enterprise. Broadening participation is defined in terms of individuals from groups underrepresented in STEM as well as institutions and geographic areas that do not participate in NSF research programs at rates comparable to others.[1] This concept continues to be a core value of the Foundation, expressed as being broadly inclusive, integrated into the Foundation's strategic goals, and embedded in the merit review criteria. Additionally, the congressionally mandated Committee on Equal Opportunities in Science and Engineering (CEOSE) advises NSF on policies and practices to encourage the full participation of underrepresented groups (women, underrepresented minorities, and persons with disabilities) in all levels of the nation's science, technology, engineering, and mathematics (STEM) workforce. In addition, other reports such as *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads* (NRC, 2011), *Staying Competitive: Patching America's Leaky Pipeline in the Sciences* (University of California, Berkeley, (2009), and *Beyond Bias and Barriers* (NAS, 2007) have informed NSF's efforts on this issue.

In 2008, the Broadening Participation Working Group, in consultation with other NSF staff, senior management, and advisory committees, identified seven action items to strengthen broadening participation in NSF programs and processes. The implementation framework included actions to broaden the pool of reviewers, train NSF staff and reviewers, ensure accountability for NSF staff and principal investigators, communicate guidance and promising practices, and maintain a portfolio of relevant programs. The NSF response and approach entailed interrelated policies, strategies, and programs to address the underrepresentation challenge in STEM disciplines. In fact, CEOSE commended NSF for its outstanding leadership in broadening participation in STEM throughout the government and throughout America's scientific community. "Indeed, broadening participation constitutes an important thrust across the Foundation." [2]

The Foundation is advocating that the challenges to national competitiveness and STEM leadership can be better met through the creative advantage of workforce diversity for innovation and economic empowerment. Therefore, increased participation of all of America's talent, including groups historically underrepresented in STEM must be addressed now if the US is to remain a global leader in the scientific enterprise. Preparing and engaging a diverse STEM workforce to help transform the frontier has greater urgency now given the profound demographic shifts underway in the midst of significant new opportunities for science innovation. Therefore, efforts to advance broadening participation in STEM must be accelerated in order to achieve the Foundation's strategic goals and to meet the critical national need for a diverse STEM workforce and a robust STEM enterprise. This heightened attention to and demand for broadening participation requires the Foundation to reassess and strengthen its intellectual, financial, and organizational commitments to the achievement of diversity and inclusion within all education and employment levels of STEM.

Building upon a long standing commitment to broadening participation, NSF is charging this working group to examine programmatic/strategic challenges and opportunities as well as to recommend strategic actions to lead the nation forward in developing a globally engaged, diverse workforce well prepared for working at the scientific frontiers and innovating for society. In this context, the working group will:

- Develop options in response to the 2011-2012 CEOSE recommendation that *"NSF should implement a bold new initiative, focused on broadening participation of underrepresented groups in STEM that emphasizes institutional transformation and system change; collects and makes accessible longitudinal data; defines clear benchmarks for success; supports the translation, replication and expansion of successful broadening participation efforts; and provides significant financial support to individuals who represent the very broadened participation that we seek."*
 - The options should identify key characteristics essential to the bold initiative envisioned, especially including issues of scale and scope; innovations and integration; and accountability (e.g., evidence/knowledge-base, evaluation).
- Develop a new strategic framework for action, covering:
 - policies to enhance broadening participation;
 - enhancements to NSF's systems, processes and infrastructure for advancing the broadly inclusive core value;
 - strategic outreach, engagement and partnerships to increase diversity and inclusion at scale;
 - innovative accountability measures for documenting and acknowledging success and meeting federal reporting requirements related to equal opportunities; and
 - technological solutions for sharing best practices and lessons learned, as well as ensuring an ongoing dialogue regarding the value of diverse STEM workforce. In the development of a new framework for action, NSF recognizes that any strategy must be ongoing and at scale as well and be receptive to the changing circumstances and local needs.

The Working Group should submit its recommendations for a broadening participation initiative by June 30, 2014 and a framework for action by July 31, 2014. The Group should also provide periodic updates to SMaRT on its activities and on upcoming internal and external milestones related to its Charge.

Working Group Membership:

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 Dr. Bevelee Watford
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[1] NSF. *Broadening Participation at the National Science Foundation: A Framework for Action*, 2008. CEOSE. 2011-2012 Biennial Report to Congress, 2013, p. 21.

